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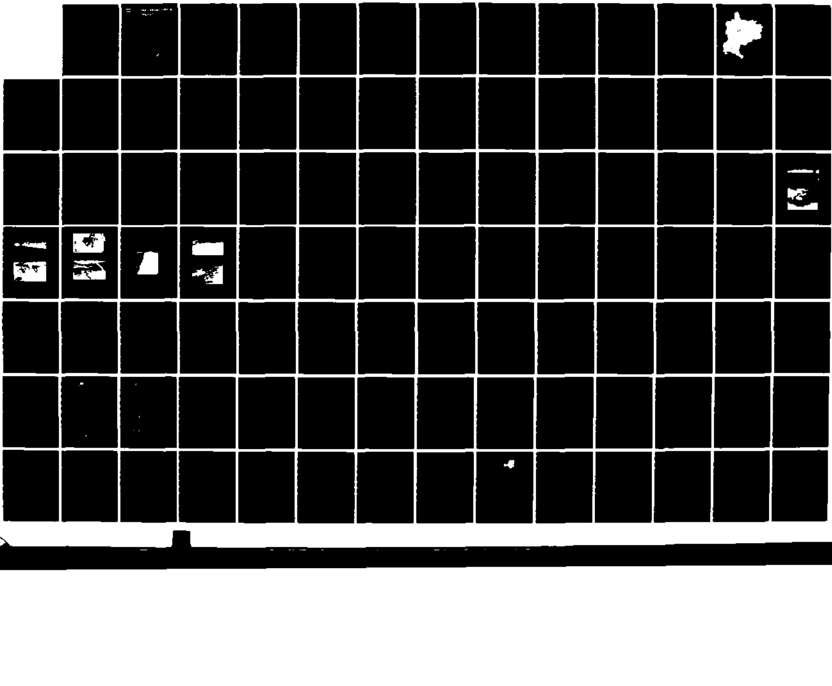

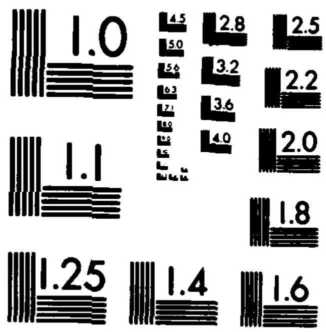

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US Army Corps of Engineers
St. Paul District

Reconnaissance Report

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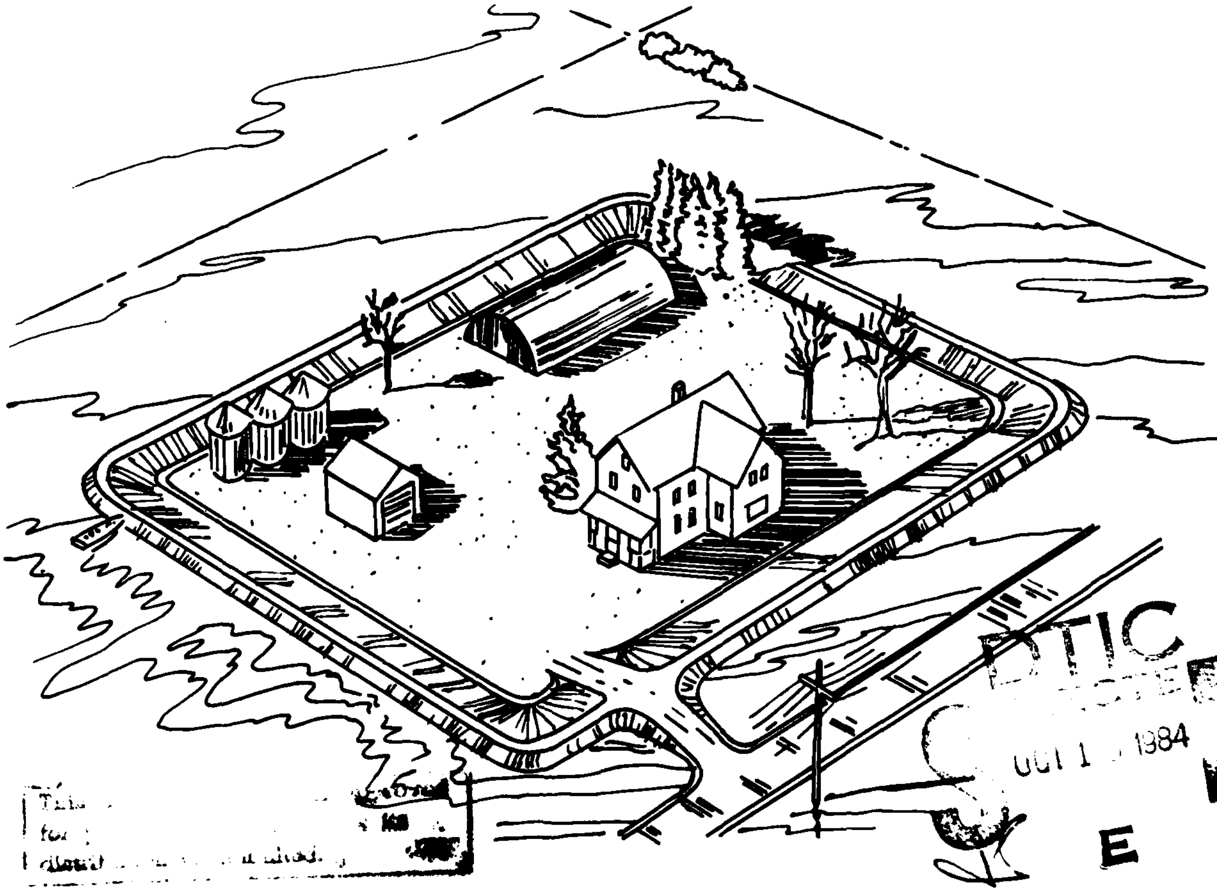
AD-A146 629

Red River of the North
Walsh and Pembina Counties, North Dakota
Farmstead Ring Levees



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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This reconnaissance report provides the public the initial information needed to assess the potential for Federal involvement in developing ring levees for the floodprone farmsteads along the Red River of the North in northeastern North Dakota. Included in the general study area is the North Dakota side of the Red River main stem 100-year floodplain from Oslo, Minnesota, to the international border near Pembina, North Dakota. Specifically, the study area encompasses the reach of the Red River that flows through Walsh and Pembina Counties, North Dakota. The study area includes the townships of

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Walshville, Pulaski, Acton, and St. Andrews in Walsh County and Drayton, Lincoln, Joliette, and Pembina in Pembina County. The communities located within the study area include Drayton, Joliette, Bowesmont, and Pembina, North Dakota.

FARMSTEAD RING LEVEE

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INTRODUCTION

Throughout history, flooding in the Red River Valley has caused human hardship for residents. Historical records indicate that major floods have occurred in 1882, 1883, 1893, 1897, 1916, 1943, 1947, 1948, 1950, 1952, 1965, 1969, 1975, 1978, and 1979.

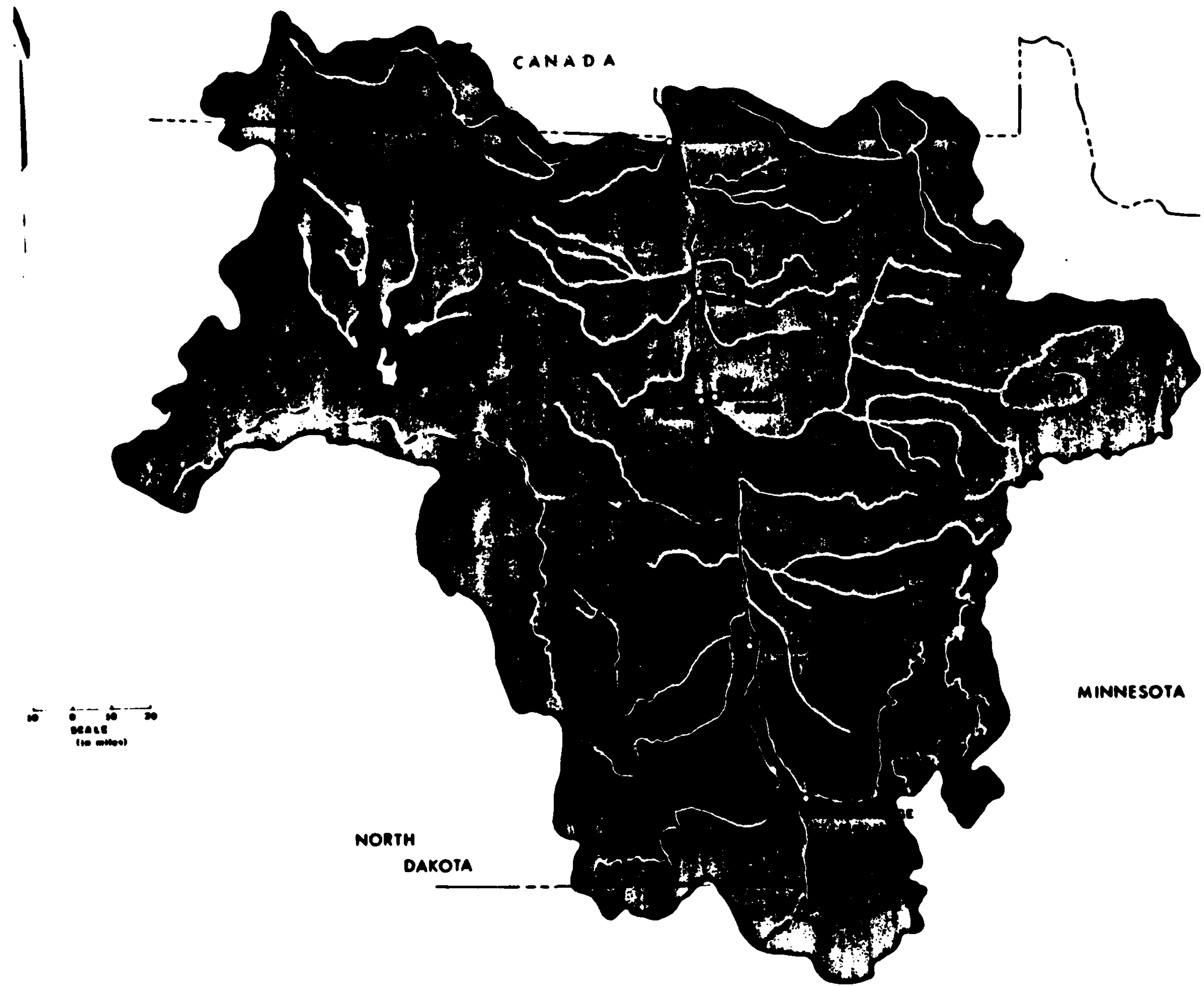
Average annual flood damages throughout the basin approach $50 million and damages to farmsteads alone constitute a significant portion (about 14 percent) of this total. The Red River farmstead is in essence a small business consisting of grain silos with grain, heavy equipment, houses, buildings, etc. A good portion of the Nation's agricultural economy and the regional economic stability depend upon the success of the farmers in the Red River Valley. Local people are concerned about their future should flooding of recent magnitudes continue, and they have demanded action by all water resource agencies. Typical flood damage reduction alternatives to help floodplain farmers along the Red River main stem are not viable or practical within existing means. Innovative solutions, such as farmstead ring levees, have evolved as a positive step toward reducing flood damages.

THE STUDY AND REPORT

PURPOSE AND STUDY AREA

This reconnaissance report provides the public the initial information needed to assess the potential for Federal involvement in developing ring levees for the floodprone farmsteads along the Red River of the North in northeastern North Dakota. Included in the general study area is the North Dakota side of the Red River main stem 100-year floodplain from Oslo, Minnesota, to the international border near Pembina, North Dakota (see the following photograph). Specifically, the study area encompasses the reach of the Red River that flows through Walsh and Pembina Counties, North Dakota. The study area includes the townships of Walshville,

Pulaski, Acton, and St. Andrews in Walsh County and Drayton, Lincoln, Joliette, and Pembina in Pembina County. The communities located within the study area include Drayton, Joliette, Bowesmont, and Pembina, North Dakota.



RED RIVER OF THE NORTH BASIN

LEGISLATIVE BACKGROUND

Requests for an evaluation of flood control alternatives for the study area were made by the North Dakota Red River Joint Water Management Board and the Walsh County Water Management District in 1980.

Various resolutions passed by the Senate and House Committees on Public Works serve as the authority for conducting the study. These resolutions are presented in Appendix A.

SCOPE

The study is of reconnaissance scope and covers the area included in the 100-year Red River main stem floodplain in Walsh and Pembina Counties, North Dakota. Specifically, this includes approximately 120,000 acres of floodplain along the Red River of the North between Oslo, Minnesota, and the international border as shown on figure 1. Definition of the study area was closely coordinated with the State of North Dakota and the Soil Conservation Service to assure maximum attention was given to the critical floodprone areas of the basin.

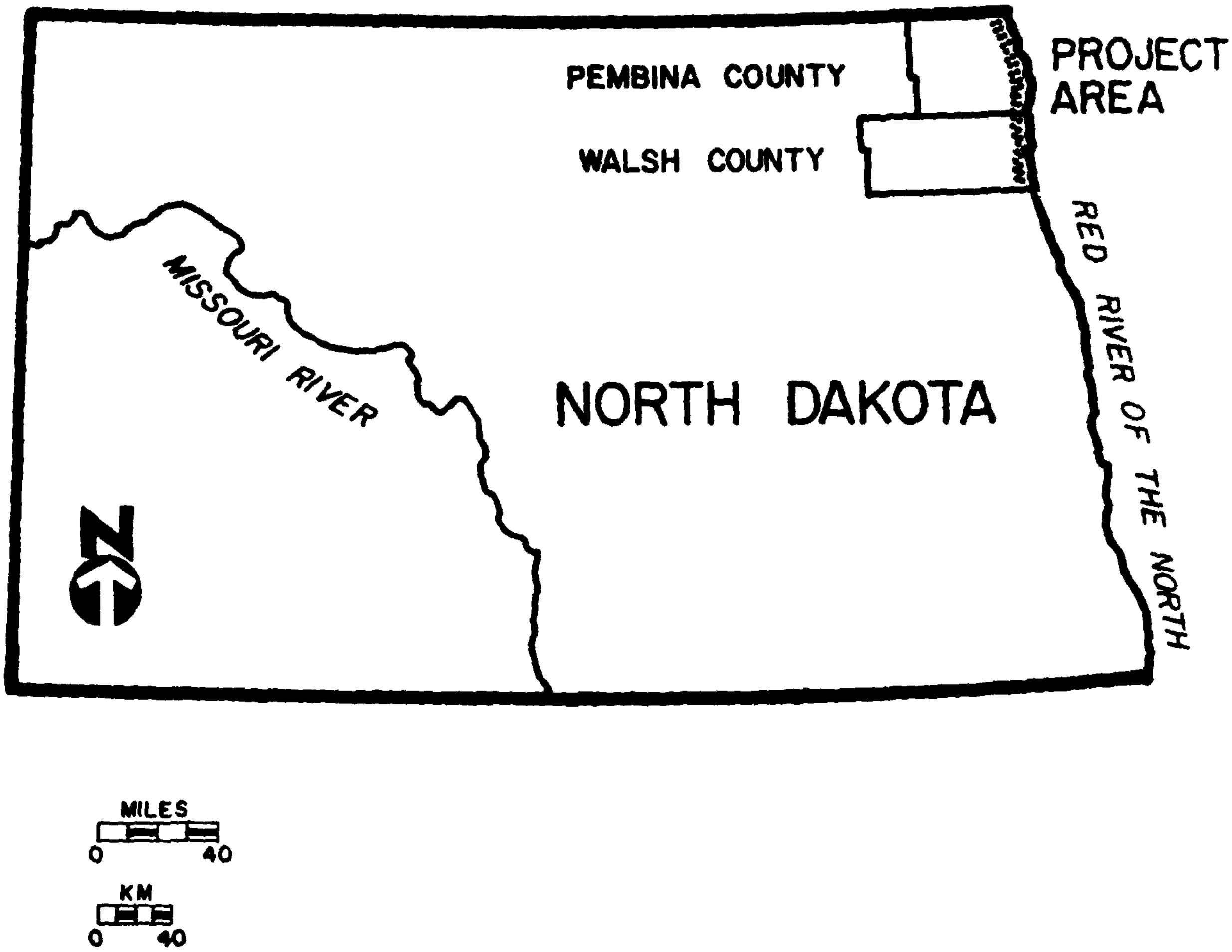


FIGURE 1

Map showing the location of the ring levees project area, Pembina and Walsh Counties, North Dakota.

The interest in farmstead ring dikes is predominantly on the North Dakota side of the river because many farmers on the Minnesota side either have developed ring dikes on their own or are protected by agricultural levees. Minnesota farmers were able to accomplish this because topography and higher floodplain elevations permitted levees to be developed easily and at much less cost.

Several flood damage reduction alternatives were investigated to determine economically and environmentally justifiable solutions to the farmstead flooding problem. Alternatives investigated included nonstructural solutions of ring levees, raising buildings, floodproofing, and evacuation. All structural solutions were eliminated from further study in the 1980 Red River basin preliminary basin-wide review study.

Survey and economic data were gathered at about 350 potential farmsteads of which 182 were determined to be inhabited and operated for farming practices. For each alternative, preliminary economic analyses were performed on the 182 inhabited/operational farmsteads using the information gathered, recently completed hydrology and hydraulic studies for the Red River main stem, and up-to-date costing information. Preliminary environmental analyses including a cultural resource investigation of a 15-percent sample of farmsteads were completed. Recommendations were based on the results of the economic and environmental studies.

The report contains five appendixes. Appendix A provides a copy of the congressional resolutions for study authority. Appendix B summarizes past and present actions of the Corps of Engineers and discusses the ring levee work in Grand Forks County, North Dakota, and in Manitoba, Canada. Appendix C consists of technical information on economics, hydrology, hydraulics and the environment. Appendix D contains correspondence. Appendix E details the natural disaster emergency operations plans for Walsh and Pembina Counties.

RED RIVER BASIN ACCOMPLISHMENTS/ACTIVITIES

This section details what the Corps of Engineers has accomplished, what is ongoing, and what work remains to be done on the Red River under the general basin authorities. Additional information on all completed projects and ongoing programs of the Corps under all authorities is provided in Appendix B.

HISTORY OF CURRENT BASIN STUDY

The widespread near-record floods of 1950 placed additional emphasis on the need for flood control in the Red River basin. Numerous congressional resolutions (Appendix A) were passed to demonstrate the concern and need for prompt action. This urgency for action resulted in the current Red River of the North basin study being initiated in 1956. Immediately, several critical flood problem areas were identified for special attention. Studies in these areas have resulted in the authorization of several projects and the construction of a channel improvement project. More recent basin studies have continued to concentrate on the critical flood control concerns and to develop a base from which basin-wide concerns can be properly addressed. In addition, current studies play an active part in maintaining coordination activities with the various water resource interests and in participating in the ongoing integrated basin-wide comprehensive planning process. The accomplishments and projects are many and are briefly summarized in the following table.

Red River of the North Basin
Summary of Basin Study Products

Products	Date completed	Description or recommendations	Comments
Plan of study	1957	Identified a number of critical areas for prompt attention.	--
Interim Survey, South Branch Wild Rice River-Felton Ditch	1962	Recommended channel improvement.	Constructed 1982.
Water use study	1964	Considered water availability and use for the entire Red River basin.	Important for early water use decisions.
Interim reports	Various	Recommended additional interim studies.	Several reports were completed.
Plan of survey	1967	Identified priorities and schedules for future actions.	--
Interim survey, Wild Rice River	1967	Recommended Twin Valley Lake.	Authorized for construction in 1970.
Interim survey, Sheyenne River	1968	Recommended Kindred Dam and Lake.	Authorized for construction.
Revision of plan of survey	1970	Revised priorities and schedules.	--
Interim survey, Park River at Grafton	1973	Recommended levee and bypass channel.	Authorized for phase I planning in 1974.
Feasibility study, Forest River subbasin	1975	No feasible alternatives identified.	Hydrologic analysis used to further discussions on localized flood problems.
Plan of study	1977	Identified and prioritized remaining studies with schedules.	--

Summary of Basin Study Products (continued)

Products	Date completed	Description or recommendations	Comments
Hydrologic data report	1977	Initial analysis of agricultural levee system.	Used by States of Minnesota and North Dakota to establish joint agreement on future dike construction along the Red River main stem.
Feasibility study, Red Lake River subbasin	1977	No feasible alternatives identified.	Encouraged development of local flood control projects by watershed district.
Feasibility study, Goose River subbasin	1979	No feasible alternatives identified.	Resulted in alternative development by water management board.
Low-flow computer model	1979 (1972)	Model determines effect on main stem and tributary flows of reservoir systems applied for conservation purposes.	Operational - used in urban studies and in Souris-Red-Rainy comprehensive basin study.
Grand Forks and East Grand Forks urban study	1981	Analyzed problems and recommended solutions for water supply, wastewater, flood control needs. Also developed flood emergency plans of action for both communities.	Local implementation of recommended actions has begun.
Preliminary basin-wide review study	1980	Identified future courses of action in Red River basin.(1)	Results were coordinated with interagency task force of State and local interests.
High-flow computer model	1980	Model determines the effect on main stem and tributary flows of reservoir and non-reservoir flood control alternatives.	Operational - used in ongoing Red River basin studies and in agricultural levee analysis.

(1) Recommended actions included the implementation of the Technical Resource Service under the Floodplain Management Program.

Summary of Basin Study Products (continued)

Products	Date completed	Description or recommendations	Comments
Water surface profile computer model	1980	Model determines the impacts of floodplain encroachments on various floodwater surface elevations.	Operational - used in ongoing Red River basin studies and in agricultural levee analysis.
Expected annual damages computer model	1980	Model determines the main stem benefits and residual damages for flood control alternatives.	Operational - used in ongoing Red River basin studies.
Red River basin strategy report	1981	Outlines the water resource actions the Corps plans to implement in the basin.	To be updated in early 1984.
Red River main stem technical information report	1983	Analyzes existing agricultural levees and proposed modifications and presents guidelines for future construction of agricultural levees.	Presently used to bring existing levees into compliance with State criteria.
Devils Lake pre-reconnaissance evaluation	1983	Recommended continuation of feasibility studies.	Feasibility studies are continuing.
Fargo-Moorhead urban study	N/A	Evaluating water supply, flood control, recreation, and additional water resource needs in the metropolitan area.	Ongoing.
Farmstead ring levee analysis	N/A	Assesses the potential for Federal involvement in developing ring levees for the floodprone farmsteads along the Red River of the North in northeastern North Dakota.	Ongoing.

FUTURE BASIN STUDY WORK

The preliminary basin-wide review study identified a number of future actions that should be pursued under the Red River of the North basin general authorities. Coordination of these actions with an interagency task force composed of State and local interests confirmed the need for these studies. The overall plan to implement these actions along with future actions under other authorities will be summarized in a basin strategy report (update from 1981 report) scheduled for completion in early spring of 1984. A list of the remaining basin studies under the Red River of the North general authorities is presented in the following table.

Red River of the North Basin
Summary of Future Study Actions

Remaining studies	Description	Status/schedule
Farmstead ring levee analysis, ND	Assess the potential for developing ring levees to protect flood-prone farmsteads in Walsh and Pembina Counties.	Ongoing-scheduled for completion in fiscal year 1985.
Devils Lake subbasin, ND	Analysis of the Devils Lake flooding concerns.	Ongoing-scheduled for completion in fiscal year 1987.
Fargo-Moorhead Urban Study	Evaluating water supply, flood control, recreation, and other water resource needs in the metropolitan area.	Ongoing-scheduled for completion in fiscal year 1985.
Upper and Lower Red Lakes reservoir, MN	High lake levels causing significant flood damages to shoreline property and destruction of thousands of acres of marshland are major problems that need to be addressed.	Not initiated - will prepare an appraisal report in fiscal year 1984.
Homme Dam and Lake, ND	An accelerated sedimentation problem reduced the contribution of this reservoir to meeting the flood control and water supply needs of the area.	Not initiated - will prepare an appraisal report in fiscal year 1984.
Red River main stem	Continued technical analysis to develop best overall agricultural levee solution.	As requested.
Computer models	(See previous table.)	Continual update through end of study.
Coordination	Ongoing basin-wide activities all interests require input and involvement by the Corps of Engineers, particularly the comprehensive planning efforts.	Continuing through end of study.
Red River basin report	This report will summarize all of the activities accomplished during the course of the study.	Not intiated - scheduled for completion in fiscal year 1987.

PLAN FORMULATION

The plan formulation process involves an assessment of water and related land resource problems and opportunities, description of alternative measures designed to meet the identified problems, screening of those measures, and refinement of alternatives considered for further evaluation. Each of these formulation actions is discussed in subsequent paragraphs.

PROBLEM ASSESSMENT

Problems, needs, and opportunities were identified and addressed in the preliminary basin-wide review study. This study served as a basis for the information presented in this document, including the profile of the existing and anticipated future resource base as provided in subsequent paragraphs.

PROFILE OF RESOURCE BASE (EXISTING CONDITIONS)

This profile of the resources in the study area describes the existing conditions in the basin.

Physical Setting

The Red River of the North forms most of the North Dakota-Minnesota boundary. Beginning at the confluence of the Ottertail and Bois de Sioux Rivers near Wahpeton, North Dakota, the Red River flows 395 miles in the United States across the bed of the large ancient glacial Lake Agassiz before entering Canada near Pembina, North Dakota. Over the last 116 miles, the Red River flows adjacent to the study area. North Dakota tributaries entering the Red River in this area include the Pembina, Park, and Forest Rivers. At Oslo, Minnesota, the drainage area of the Red River is 31,200 square miles. Average slope of the river in the study area is approximately 0.4 foot per mile. This gentle slope of the

river combined with runoff from the large contributing drainage area aggravates the flooding problem in Walsh and Pembina Counties.

Land Use

Agriculture is the most important economic activity in both Pembina and Walsh Counties, and represents the activity for which there is the most prevalent land use. Both counties rank high in the production of small grains compared to the rest of the State. Livestock is less important to their economy, but the counties do rank in the top third in hog production.

The following table shows their rank in the production of various agricultural products in North Dakota (of 53 counties).

Rank of North Dakota's Counties (1980)

County	Wheat	Barley	Cattle	Hogs
Pembina	3	11	48	14
Walsh	8	7	42	17

Source: North Dakota Agricultural Statistics, 1981.

The following table identifies the major crops in the counties and the total production.

1980 Crop Statistics, Pembina and Walsh Counties

Crop	Harvested Acres	Yield Per Acre	Total Production
Pembina County			
Barley	45,500	38.2 bu.	1,738,000 bu.
Beans	34,500	1,500 bu.	51,750,000 bu.
Potatoes	26,000	150 cwt.	3,900,000 cwt.
Sugar beets	24,100	17.3 tons	417,400 tons
Sunflowers	69,000	990 lbs.	68,517 lbs.
Wheat	242,800	37.5 bu.	9,102,000 bu.
Walsh County			
Barley	56,000	32.5 bu.	1,818,000 bu.
Beans	30,500	990 bu.	30,272,000 bu.
Potatoes	53,300	140 cwt.	7,462,000 cwt.
Sugar beets	26,500	13.6 tons	361,400 tons
Sunflowers	54,000	870 lbs.	46,988 lbs.
Wheat	257,800	36.4 bu.	9,381,200 bu.

Source: North Dakota Agricultural Statistics, 1981.

The number of farms in Pembina and Walsh Counties has been decreasing while the average size of the farms has been increasing, making farming a bigger business than in the past. The following table illustrates this trend.

Number and Average Size of Farms - 1969 and 1978

	Number of Farms		Average Size of Farms	
County	1969	1978	1969	1978
Pembina	1,065	946	630	720
Walsh	1,415	1,172	592	707

Source: Census of Agriculture, 1969 and 1978.

Climate

The climate of the study area is continental which is characterized by wide variations in temperature, light to moderate precipitation, plentiful sunshine, and nearly continuous air movements. Temperature variations are caused when cool dry air from the north and warm humid air from the south move quickly into the area. The precipitation pattern is varied, but generally increases from west to east.

The 30-year average maximum temperature ranges from 9°F in January to 81°F in July while the 30-year average minimum temperature ranges from -11°F in January to 55°F in July as shown in the following table. Precipitation ranges from a 30-year average low of 0.41 inch in February to a 30-year average high of 2.90 inches in July. Most of the year's precipitation occurs between May and September. Snowfall averages about 38 inches per year, which is about 21 percent of the annual precipitation.

Temperature and Precipitation Normals for Pembina, North Dakota, (1951 through 1980)

Month	Maximum Temperature (°F)	Minimum Temperature (°F)	Precipitation (inches)
January	9.4	-11.2	0.50
February	17.4	-5.1	0.41
March	29.8	8.9	0.69
April	50.8	28.3	1.33
May	67.3	40.2	2.42
June	76.3	50.5	2.86
July	81.3	55.3	2.90
August	79.8	52.4	2.65
September	69.0	42.7	2.19
October	56.6	32.5	1.09
November	34.7	16.3	0.55
December	18.5	-0.7	0.51

Source: James Zandlo, State Climatology Office, Minnesota Department of Natural Resources

Environmental Resources

The study area is situated within the Agassiz Lake Plain Region and the Northeastern Drift Plain of the Prairie Pothole Region. The potential natural vegetation in these biotic areas includes the northern floodplain forest, tall grass prairie, and eastern mixed grass prairie. Agricultural development has eliminated or altered most of the original vegetation communities. Approximately 80 percent of the land in Pembina and Walsh Counties is under cultivation.

Natural vegetation in the study area is limited in both extent and diversity. Forested areas are confined primarily to narrow bands of vegetation along rivers. Common tree species found in these areas include American elm, green ash, box elder, and cottonwood. Wooded areas

around farmsteads are usually planted windbreaks. Few remnants of natural prairie vegetation remain with grassed areas around farmsteads being either overgrazed pasture or residential in nature. The majority of the wetlands in Pembina and Walsh Counties are found in the western portion of the counties.

Important wildlife habitats in the study area are the remaining woodlands, wetlands, and grasslands. The forested areas provide den and nesting sites, winter and escape cover, and travel corridors for many resident and migratory species in the region. The grassland areas, when found in combination with wetland complexes, form a dynamic and diverse ecosystem which supports a wide variety of birds, mammals, invertebrates, and plants. Because of their importance as wildlife habitat and the limited areal extent of these communities, there is a need to protect, conserve, and enhance those areas wherever possible.

The white-tailed deer is the most important big game animal in the study area. Lack of habitat has resulted in low numbers in most of these two counties. The Hungarian partridge is the most abundant upland game bird. The most common breeding waterfowl in the area are the mallard, blue-winged teal, pintail, gadwall, and northern shoveler.

Other wildlife common to the area includes red fox, rabbit, raccoon, muskrat, and a wide variety of birds.

The water quality of many of the streams in the study area is moderate to poor, due to periods of intermittent flow, channelization, and agricultural runoff. However, most reaches of the major rivers do have a moderate forage or sport fish production.

Human Resources

The human resources of the study area can be described by data on such elements as population, employment, education, income, recreation, cultural, and transportation characteristics.

Population. The populations of Pembina and Walsh Counties have been steadily decreasing in recent decades. Farm population, which represents a major portion of the total, has been decreasing as the demand for farm labor has also decreased. In Pembina County, farming was the principal occupation on 843 farms in 1974 and on 825 farms in 1978 while in Walsh County farming was the principal occupation on 1,099 farms in 1974 and on 1,029 farms in 1978. Demand has decreased because of increased farm mechanization and consolidation of farming practices into a small business. Consequently, people moved from the rural areas to the urban areas in search of employment. The cities of Drayton and Pembina have experienced a general increase in population since 1950. Population figures for the counties and cities in the study area are presented in the following table.

County and City Populations for Study Area

City or County	Year 1950	1960	1970	1980
Pembina County	13,990	12,946	10,728	10,399
Walsh County	18,859	17,997	16,251	15,371
Drayton	875	940	1,095	1,082
Pembina	640	625	741	673

Employment. Although on-farm employment has been decreasing, employment in that sector has increased because of a general increase in agricultural services. Employment for nonagricultural sectors has also increased, particularly for services, manufacturing, and wholesale and

retail trade. From 1970 to 1980, total employment has increased in Pembina County from 3,238 to 4,083 (26 percent) and in Walsh County from 5,238 to 5,765 (10 percent). Employment by industry for the two counties is shown in the following table.

Employment Characteristics for Pembina and Walsh Counties, 1970-1980

Item	Pembina County 1970	Pembina County 1980	Walsh County 1970	Walsh County 1980
Total employment	3,238	4,083	5,238	5,765
Agriculture, (1) forestry, fisheries and mining	745	1,031	1,335	1,515
Construction	150	207	241	366
Manufacturing	331	394	211	188
Transportation, communications, and utilities	236	239	377	369
Wholesale trade	71	197	358	292
Retail trade	599	730	838	1,052
Finance, insurance, and real estate	147	134	136	180
Services	757	961	1,577	1,637
Public administration	202	190	165	166
Unemployment				
Number of people	131	232	233	347
Percent of labor force	3.9	5.4	4.3	5.7

(1) Includes agricultural services as well as farming.

Education. Several public schools provide kindergarten through high school education for the study area. University, college, and vocational training are available outside the area at Devils Lake and Grand Forks, North Dakota, and Crookston, Minnesota. Educational attainment is a high school degree or better for almost 50 percent of the population.

Income. Farm income accounts for more than half of the personal income of residents in the study area. Fluctuating farm prices are the primary determinants of income changes from year to year, although severe flooding also causes a decline in income. The fluctuations are characteristic of the basin's agricultural economy and generally result from variations in the price of wheat, the major crop of the area.

Recreation. Existing outdoor recreation facilities are limited within the study area. Presently, all but one of the sites are located within the municipalities scattered along the river. The ones that do exist are well maintained and appear to be used regularly for a variety of activities. The following table presents an inventory of existing recreation areas.

Existing Recreation Areas

Name	City/County	Activities/Facilities
Minnesota		
Oslo Municipal Park	Oslo/Marshall	Camping (no facilities) Picnicking Picnic shelter Picnic tables Large charcoal pit Restrooms Ballpark
North Dakota		
Drayton Municipal Park	Drayton/Pembina	Camping Picnicking Picnic shelters (3) Picnic tables Play area Charcoal grills Swimming pool Tennis courts (2) Restrooms Ballpark
Drayton Municipal Golf Course	Drayton/Pembina	Golf (9 holes)
Pembina Masonic Historic Park	Pembina/Pembina	None
Pembina Historic Site	Pembina/Pembina	Picnicking Charcoal grills Play area Ball park
Red River Access	Pembina/Pembina	Boat ramp Fishing
Red River Access (N.D. WMA)	Drayton/Pembina	Boat ramp Fishing

Camping facilities are available only at Drayton Municipal Park and Oslo Municipal Park. Other than these two locations, the nearest camping is located south of Grand Forks, North Dakota, and in Grafton, 10 miles from Interstate Highway 29. The latter site is well out of the 100-year floodplain.

Picnic facilities are somewhat more numerous. Oslo Municipal Park, Drayton Municipal Park, and Pembina Historic Site all provide tables and shelters. Along the entire 140-mile stretch of river, only two boat access points exist. Both are in Pembina County.

It must be noted that opportunities for hunting, birdwatching, fishing, sightseeing, and nature study can be found at locations independent of designated recreation areas. The entire study area, therefore, is considered a recreation resource.

Cultural Resources. Archeological and historical investigations in Walsh and Pembina Counties have been small in number and poorly reported. Therefore, there are few known prehistoric or historic sites in the study area. During 1983, the St. Paul District conducted a statistically valid cultural resource survey of selected farmsteads in the study area. This survey resulted in the location of six prehistoric archeological sites. Interviews with local informants also led to the location of three prehistoric archeological sites, two log houses, an abandoned historic townsite, and one historic site lead. Additional information on this cultural resource investigation is available in appendix C of this report.

Transportation. The roads in Pembina and Walsh Counties form an important part of the highway network necessary to serve the agricultural economy. The existing roads include a major Federal highway (U.S. Highway 81) in addition to Interstate 29, State trunk highways, county roads, and town roads. No municipal airports are located in the study area, although there are a number of private or turf-surfaced runways in the area which offer limited or emergency service. Commercial air travel is available at Grand Forks, North Dakota, and Winnipeg, Manitoba. The Burlington Northern Railroad serves the area and directly links it with the larger community of Grand Forks.

Water Supply and Water Quality

Domestic and commercial water supplies are obtained from the Red River of the North and the Pembina River for Drayton and Pembina, respectively. Farmsteads, rural areas, and the smaller communities utilize water from a rural water distribution system. This water is obtained from groundwater sources outside the study area.

Most groundwater is obtained primarily from aquifers in Pleistocene glacial drift. Supplies appear to be sufficient to meet any water supply demands in the near future. Surface waters are not as assured as groundwater sources. Natural streamflows throughout the area vary greatly on a seasonal and yearly basis with peak flows usually occurring in the spring and low flows in the late fall and winter. Even with these conditions, the surface waters are expected to be adequate for near future water supply demands.

The water quality in the Red River of the North has been degraded by municipal and industrial discharges and agricultural runoff. Fecal coliform concentrations appear to be the most persistent problems of the main stem with the coliform bacteria populations exceeding the accepted standards (200 col/100 ml). Low streamflows during the late summer and winter further degrade the water by concentrating these bacteria and ultimately reducing the dissolved oxygen levels. Turbidity levels are also increased because of the low flows. Agricultural operations contribute additional phosphorus and nitrogen concentrations into the Red River, which occasionally create potential problems.

The groundwater quality is adequate for domestic use although dissolved solids present problems and although sulfates and manganese are occasionally excessive.

ANTICIPATED FUTURE "WITHOUT PROJECT" CONDITIONS

Prediction of future conditions requires careful analysis of the existing setting, the trends now developing, and the limitations of the resource base. When determining the effects of any proposed major Federal action, the predicted setting with the proposed project in place must be compared with the setting as it would be without the project. This "with and without project" assessment requires a reasonable estimate of future conditions. The following is a description of the estimated most probable future "without project" condition.

Although the number of farmstead has been decreasing, the size of farms in Walsh and Pembina Counties has been increasing over the past years. As farms become larger, the value of the farmstead also increases, and profits are then sunk into new buildings, machinery, grain storage facilities, and shelter. Some farm buildings that have been extensively damaged in floods are being abandoned and replaced with newer, larger structures. Also, some farmsteads are being abandoned, although the occurrence of this will be infrequent. These trends are most likely to continue in the future.

It is unlikely that individuals will move the real property of the farmstead to areas outside the floodplain. Such a move would significantly increase the operational costs beyond that which would be economically worthwhile. Consolidation may occur to individual farmsteads as new facilities are constructed; however, this is expected to be a slow process.

With the increase in farm size and value will come a corresponding increase in the monetary and nonmonetary flood losses now occurring on farmsteads. This results from the increased capacity to store harvested grain, the addition of new buildings or modification to existing buildings, and the changes occurring to the value of contents over time.

Some individuals may attempt to provide farmstead ring levees on their own. However, the number of individuals taking this action will probably be small because the existing topography and lower floodplain elevations on the North Dakota side of the basin contribute to the difficulty and cost of constructing ring levees. Also important is the experience that individuals who owned ring dikes had during the 1979 flood. It was during this flood event that the designs, heights, and conditions of the existing ring levees were found to be inadequate to withstand the floodwaters. Thus, significant flood damages were sustained despite the ring levees being in place.

Privately constructed agricultural levees are limited to a small reach along the Red River main stem near Oslo. In North Dakota the levee system is discontinuous and likely will not be improved as a result of the State of North Dakota agreement with Minnesota. Joint criteria for regulating existing and proposed agricultural levees in both States have been adopted. It is unlikely that additional levees will be constructed by either State. Therefore, existing or proposed levees will not influence future farmstead conditions in the study area.

PROBLEMS, NEEDS, CONCERNS, AND OPPORTUNITIES

Of the potential types of water resource management and related problems, flooding is of primary concern in the study area as expressed by the public. Flood damages occur throughout the study area and pursuing flood control actions has been a long-time effort of many of the residents of Pembina and Walsh Counties. This is evidenced by the extensive flood control efforts that have occurred since 1950.

Because of the magnitude and frequency of recent floods, there has been a gradual increase in local water resource efforts with limited financial and/or technical assistance provided by the State of North Dakota. Presently operating in the study area are Water Management Boards with decision-making powers and responsibilities for local water resource

actions. Revenues are generated from the existing tax base. Basically, local interests are actively involved in water resources planning and implementation activities. The emphasis of this local program has been with small scale (localized) flood control projects and management measures which complement the existing and potential larger Federal projects. Federal assistance is needed to attack the larger flood losses in the rural areas.

The need for flood control has been expressed privately through letters and meetings, and by construction of 19 miles of individually financed agricultural levees located adjacent to the Red River main stem. In the study area, the levees are nearly continuous along the river through Walshville Township. Additional agricultural levees were constructed upstream of the study area in North Dakota and across the river in Minnesota. At present in the study area, however, some of these levees have either been removed or lowered. Concern has been expressed over the potential adverse impacts of this uncontrolled levee construction. As a consequence, the States of North Dakota and Minnesota have agreed on criteria for regulating levee construction. The criteria state that levees cannot increase the stage of the 100-year flood by more than one-half foot. Existing levees exceed State criteria, and legal actions are being taken to bring these levees into compliance.

The opportunities for implementing flood damage reduction measures that would have a significant influence on flooding in the study area are extremely limited. It must be recognized that there is no easy solution to the water resource problems in the study area. It is well documented in past and recent reports and studies that there are no large scale structural measures being considered, either singly or in combination, which would completely resolve or significantly reduce the farmstead flood problems. In fact, the constraints of the basin topography, the limits of economic and environmental feasibility, the potential for projects adversely impacting the Canadian portion of the basin, and the concern raised by private levee action will leave many of the flooding

problems in the study area unresolved. Farmstead ring levees, raising farm buildings, and floodproofing farmsteads appear to create the greatest potential for reducing flood damages in this area of the Red River basin. No other solution eliminates this need to protect the valuable commodities in the basin. This opportunity is supported by local and State interests and is compatible with any other basin-wide alternatives and plans.

Canada instituted a similar program in their portion of the Red River because they found no other feasible measures. Economics (regional and national), social well-being, low cost, and reduction in flood damages are all important advantages. However, the greatest benefit is that the majority of agricultural land would still be available for temporary storage of floodwaters. This is very important because, without this temporary storage, the flood problem would be transferred to other areas of the basin or to Canada.

Ring levees for farmsteads in the Canadian portion of the Red River Valley are in place through implementation of "the Canada-Manitoba Moving, Raising, Dyking Program." The Soil Conservation Service (SCS) has initiated a similar effort for Grand Forks County under their Resource Conservation and Development Program. Two SCS levees have been constructed; however, funding is limited and completion of ring levees for the 38 floodprone farmsteads will take time. In addition, discussions with the North Dakota State Water Commission and SCS have resulted in the SCS pursuing ring levees for farmsteads located in Cass County, North Dakota, once the levees in Grand Forks County are completed.

FLOODING

The topography of the Red River Valley is an important factor influencing flood occurrences. High flows are normally confined within the deeply entrenched tributary channels in the escarpment and beach ridge areas but, as the stream slopes become more mild and the tributary channels combine with the Red River main stem, the capacity decreases. This is particularly true in the flat valley area near the study area as the floodwaters escape the channel and move overland, inundating thousands of acres of farmland and even entire communities. Snow and ice accumulations in stream channels and ice jams, especially at river bridges and constricted reaches, often increase upstream river levels causing localized flooding. Standing and fallen trees, brush, and sediment deposition within channel banks also tend to reduce the flow-carrying capacities of streams and ditches. Even wind-blown silt may accumulate in ditches and channels, further reducing flow-carrying capacities.

Summer floods are characterized by high peak flows on the tributaries, but much less volume of runoff than the spring snowmelt floods. The lesser runoff volumes are usually not sufficient to cause major flooding of the Red River. However, in 1975, a significant summer storm which centered near Fargo, North Dakota - Moorhead, Minnesota, and near Crookston, Minnesota, caused a considerable amount of runoff, flooding farms on the Red River main stem.

The northward flow direction of the Red River is another unique and important element which often influences the magnitude of main stem floods. Warming spring temperatures which produce snowmelt runoff normally progress slowly from the southern headwaters portion of the basin toward Canada. Hydrologic analysis of past tributary and main stem flood peaks indicates that local and tributary runoff, particularly in the southeastern quadrant of the basin (study area), often tends to synchronize with the Red River main stem flood peak stage and increases

the volume. Also, spring floods from melting snow begin in the headwaters and flow into an area that may be blocked by the winter ice cover. The channel ice causes backwater and localized increases of flood stages.

River gaging data covering flood occurrences prior to 1873, when a river gage was established at Grand Forks, are not available in the United States. However, early records maintained near Winnipeg, Manitoba, indicate that several major floods occurred in the 1800's. The most notable of these were the 1826, 1852, and 1861 floods which exceeded by several feet the greatest floods of this century at Winnipeg. The flood of 1826 destroyed nearly all settlements in the valley and delayed further settlement for many years.

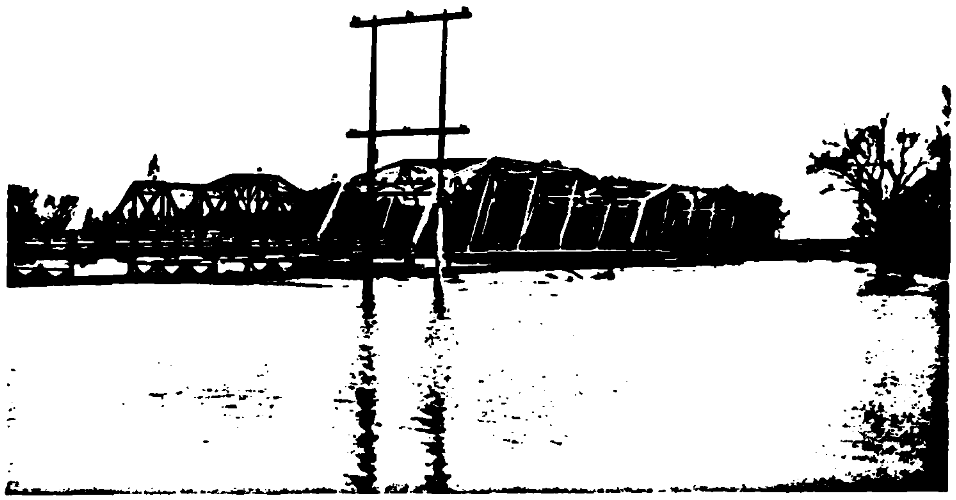
High-water marks, stage records, and flow measurements recorded at Oslo, Drayton, and Emerson, Manitoba, since 1873 reveal that major flooding occurred generally in this reach of the river in 1882, 1883, 1893, 1897, 1916, 1943, 1947, 1948, 1950, 1952, 1965, 1966, 1969, 1970, 1972, 1974, 1975, 1978, and 1979. All of these floods, except those of 1965 and 1975, were caused by spring snowmelt. The 1965 flood was triggered principally by heavy widespread rainfall on deeply frozen soil. The greatest recorded floods in the United States portion of the basin were those of 1897, 1950, and 1979.

Historic peak flood elevations and discharges for the Red River of the North main stem within the study area are given in the following table. The photographs which follow depict the seriousness of the flooding experienced in 1978 and 1979.

Historic Peak Flood Elevations and Discharges for the Red River Main Stem[1]

	Gage Location											
	Oslo (2)				Drayton (3)				Emerson (4)			
Year	Date	Gage Height (feet)	Elevation (cfs)	Peak Discharge (cfs)	Date	Gage Height (feet)	Elevation (cfs)	Peak Discharge (cfs)	Date	Gage Height (feet)	Elevation (cfs)	Peak Discharge (cfs)
1882		35.9	808.6							88.7	788.7	
1883												
1893												
1897		36.6	809.3		Apr	42.4	797.4			90.0	790.0	
1916		35.5	807.2						24 Apr	86.5	786.5	46,200
1943	13 Apr	29.16	806.81	27,300	17 Apr	33.6	790.1	28,700	20 Apr	77.54	776.97	29,500
1947	21 Apr	35.33	807.93	33,800	28 Apr	34.5	789.5	29,300	28 Apr	76.07	776.07	28,400
1948	17 Apr	36.17	808.82	41,400	21 Apr	41.5	796.5	57,000	27 Apr	87.62	787.62	51,800
1950	25 Apr			48,400	26 Apr			71,500	10 Apr			73,200
1950	10 May	31.83	809.48	63,000	12 May	41.85	798.0	86,500	11 May	90.89	790.89	95,500
1952	23 Apr	25.47	803.12	24,800	25 May	28.83	785.3	23,900	24 Apr		773.0	24,200
1965		36.10	808.84	50,600	22 Apr	40.43	795.43	47,200	26 Apr	85.19	785.19	46,200
1966	4 Apr	37.08	809.73	59,000	8 Apr	42.15	797.15	67,500	11 Apr	89.15	789.15	66,800
1967	4 Apr	34.55	807.2	32,000	8 Apr	36.70	791.9	32,200	9 Apr	80.79		33,600
1969	17 Apr	36.92	809.57	56,500	19 Apr	41.35	796.36	59,000	26 Apr	87.59	787.61	54,700
1970					29 Apr	38.20	793.2	31,700	29 Apr	84.72	784.72	39,600
1972					20 Apr	35.73	790.73	31,100	24 Apr	78.16		30,700
1974					25 Apr	39.85	794.85	43,900	28 Apr	86.51	786.51	43,500
1975	15 Jul		808.6	42,400	4 May	39.8	794.85	44,000	8 May	84.32	784.32	42,800
1978	12 Apr		810.56	56,200	16 Apr	41.19	796.19	56,200	18 Apr	86.89	786.89	50,600
1979	22-25 Apr	38.6	811.25	91,000	28 Apr	43.66	798.66	92,900	1 May	91.19	791.19	92,700

(1) Peak discharge often follows peak stage by one or two days.
(2) Drainage area - 31,200 square miles, period of record - 22 years, gage zero - 772.65 (1929 adj.), location - near center span downstream side of highway bridge in Oslo, river mile 271.2. This gaging station was discontinued after the 1969 flood.
(3) Drainage area - 34,800 square miles, period of record - 37 years, gage zero - 755.0 (1929 adj.), location - downstream end east pier on highway bridge 1 1/2 miles northeast of Drayton, river mile 207.0.
(4) Drainage area - 40,070 square miles, period of record - 66 years, gage zero - 700.0 (Geological Survey of Canada), datum 1928 (add 0.15 foot to get 1929 adj.), location - 3/4 mile downstream from international boundary, river mile

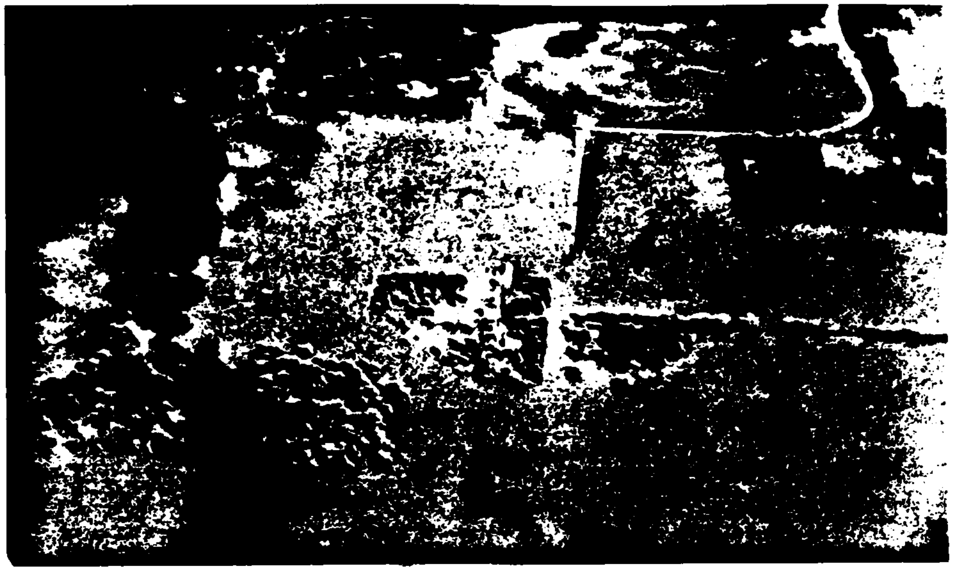


Minnesota Highway 1 Bridge and Burlington Northern Bridge at Oslo, Minnesota, downstream side of bridge (taken 8 April 1978).

April 1978 flood, taken one-half mile north of Drayton, North Dakota.

Upstream of Minnesota Highway 1 Bridge looking west, Oslo, Minnesota (taken 8 April 1978).

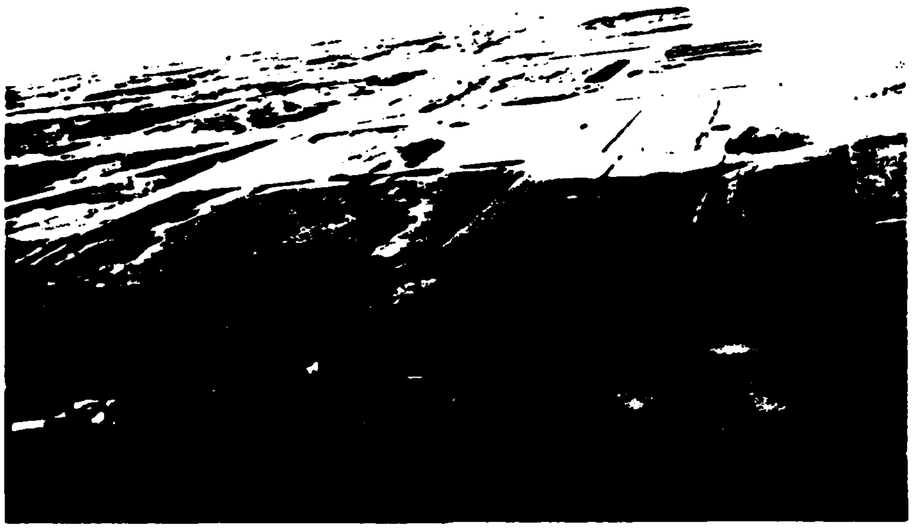
Flooded farm north of Grand Forks, North Dakota (taken 13 April 1978).



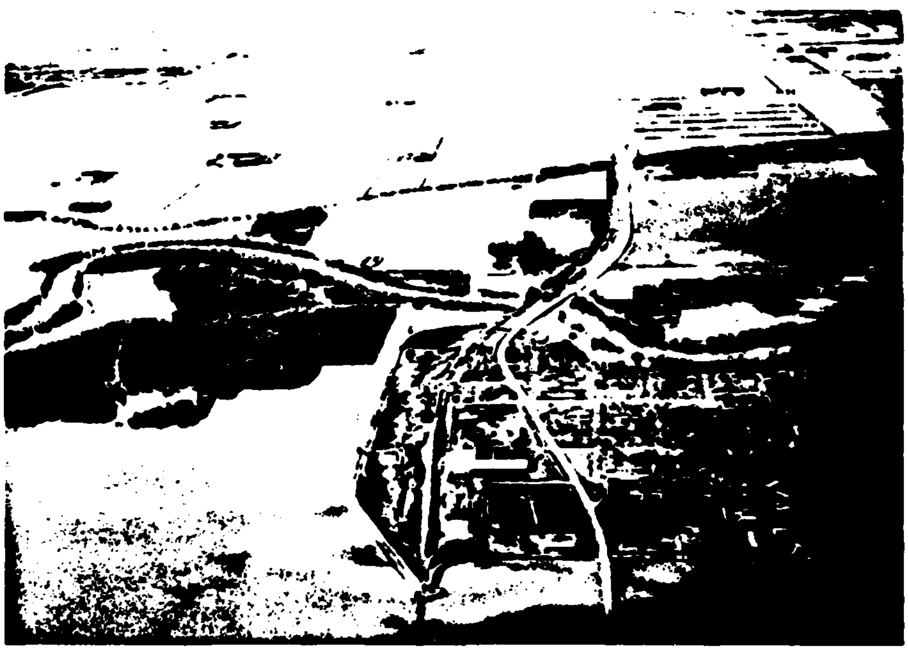
Flooded farms and roads, one mile east of Drayton, North Dakota (taken 14 April 1978).

Four miles south of Drayton, North Dakota, looking southeast toward Minnesota.

Facing West from about third street, Pembina, North Dakota (taken 10 April 1966).



Red River of the North at Drayton, North Dakota, looking northwest (taken 26 April 1979).



Red River of the North at Oslo, Minnesota, looking west (taken 26 April 1979).

STUDY OBJECTIVES

The general planning principles and guidelines for conduct of a feasibility study such as this require that all federally assisted water resource projects be planned to further the national economic development (NED) objective. This must be accomplished consistent with protecting the Nation's environment. The specific study objectives must be derived from the study area problems and, in this case, the major problem is flooding. Therefore, consistent with the Federal requirements and the identified problems, the study objective is to:

> Provide an acceptable flood damage reduction plan for farmsteads in Walsh and Pembina Counties, North Dakota, that contributes to economic stability, social well-being, and protection of life and property.

PLANNING CONSTRAINTS

Any flood damage reduction measure(s) or plan identified for all or part of the study area through the plan formulation process must be implementable. That is, the selected plan must be technically and economically feasible; socially, environmentally, and culturally acceptable; and capable of being carried out with a local sponsor.

In addition, the Executive Orders 11988 - Floodplain Management, and 11990 - Protection of Wetlands, and the Executive Memorandum on Prime and Unique Farmland should be considered as much as possible in the development of implementable plans.

IDENTIFICATION AND DEVELOPMENT OF ALTERNATIVES

The most urgent water resource need of the basin is flood damage reduction. The flooding problems occur along the Red River main stem and tributaries in the counties. No other critical water resource need has

been identified, nor is there an opportunity for water resource projects constructed in other parts of the basin to significantly reduce flood damages in the study area. Therefore, this study concentrates on alternative plans to meet the flood damage reduction need within the study area.

The alternatives considered in this study include the following:

- No action
- Farmstead ring levees
- Raising farm buildings
- Floodproofing farm buildings
- Evacuation of farmsteads

METHODOLOGY USED IN THE ANALYSIS OF ALTERNATIVES

Each flood control alternative is described by its design; effectiveness in reducing floods; benefits and costs; and impacts on biological, cultural, and social resources. Prior to discussing each alternative, a basic understanding of the data base used in this analysis is provided.

Design Conditions

The alternatives were designed to provide protection for a 100-year flood event (a flood having a 1-percent chance of occurring in any given year). This flood is 105,000, 107,000, and 122,000 cfs on the Red River main stem at Oslo, Minnesota, Drayton, North Dakota, and Emerson, Manitoba, respectively.

Flood Damage Data Base

Flood damages for the study area have been estimated using a data base most of which was collected during 1981 and 1982. This information consists of economic survey data, topographic survey data, and a

photographic inventory of all farmsteads in the study area. Economic survey data were gathered on a questionnaire which recorded information regarding land use, actual damages incurred, and recreation and sociological impacts of flooding on residents. Topographic survey data were gathered and included elevations and locations of farmstead buildings. The photographic inventory showed the farmstead buildings in the study area.

This information has been integrated with water surface profiles and flow-frequency analyses for the Red River of the North. The integration of stage-damage, stage-discharge, and discharge-frequency data allowed for estimates of average annual flood damages and potential benefits of the various flood control alternatives.

Benefits for a given alternative are the amount of flood damages reduced by that alternative. The data base is of sufficient scope and detail for the screening of alternatives. The data presented here reflect normalized 1983 price levels and an 8.128-percent interest rate. No allowances have been made for future growth of damages. In estimating flood damages and project benefits, the existing levees were assumed to provide no protection. This condition reflects actual experience as agricultural levees along the Red River in the study area failed in both the 1978 and 1979 floods.

Costs of Alternatives

To compare benefits to costs, both must be expressed in average annual figures. Average annual costs are derived by amortizing first costs (construction, lands, easements, and relocations) over a 100-year project life at an 8.128-percent interest rate. Estimates for annual operation and maintenance costs are also included.

Screening of Farmsteads for Analysis

There are approximately 350 farmsteads in the study area; however, the number of farmsteads analyzed in this study is 182. Farmsteads which were eliminated from analysis include those which did not serve as a residence and were used only for grain and/or machinery storage. Future studies will consider moving these granaries and/or machinery storage buildings to the inhabited farmsteads that presently own those buildings. Other farmsteads which were not analyzed include those which have been abandoned. Farmsteads which were analyzed were those which were considered to be viable inhabited operational farmstead businesses with resident farmers actually living on the farmsteads and operating the farms.

Selection of Floodplains

To establish equity and uniformity in considering and evaluating the various nonstructural alternatives, farmsteads were assigned to specific floodplain areas. Use of floodplains in this manner provided an appropriate grouping of farmsteads by similar flooding depth and permitted consistent evaluation of alternatives. A number of floodplains were originally considered by comparing the water surface profiles to the topography along the river; however, only the 20-, 50-, and 100-year floodplains were ultimately selected. Other floodplains were eliminated because they were not significantly different from those utilized. Figures 2 and 3 at the end of the main report locate the floodplain areas and identify the farmsteads and farmstead types in each.

DESCRIPTION OF ALTERNATIVES

Farmstead Ring Levees

Description. - Ring levees would be provided for the 182 inhabited operational farmsteads. Each ring levee would be designed to encircle

the physical portion (buildings) of the farmstead, leaving the agricultural land available as a temporary storage for floodwaters. The ring levees would be designed with a 10-foot top width and side slopes of 1-foot vertical to 3-foot horizontal. Average levee heights would vary by floodplain from 7.5 and 4 feet for the 20-year and 100-year floodplains, respectively. Three feet of freeboard would be provided above the 100-year levee flood design. The levees would be constructed of clay covered with topsoil and seeded. No riprap or inspection trench would be necessary. Generally, the ring levees would enclose a 7-acre farmyard (on the average). Destruction of windbreaks and shelterbelts would be avoided, wherever possible.

Waters that accumulate within the ring leveed areas will be limited to interior runoff originating from precipitation and snowmelt. Seepage is not a problem because of the existing soil conditions. A ponding area and associated gravity outlet will be used to handle the interior surface waters. No unnecessary flood damages are expected to occur because of temporary use of ponding areas. Also, the gravity outlet will be equipped with a slide gate that will be closed during flood events. Operation of the gate will be the responsibility of the individual landowner.

A farmstead ring dike would generally have very little effect on flood stages primarily because a relatively small amount of cross-sectional area, over a short distance, would be removed from the floodplain area. The experience with large ring dikes such as at Oslo, Minnesota, and Pembina, North Dakota, verifies this. There was no significant change in the rating curve for project and preproject conditions at both of those communities. Likewise, recent floods did not identify a significant change. As a result, this alternative would not transfer flood problems to other areas of the basin or downstream to Canada.

Benefits and Costs. - Damages to farmsteads from floods up to the design flood would be prevented. A summary of the costs and benefits for this alternative by floodplain is shown below.

Benefits and Costs for Farmstead Ring Levees Alternative

Item	20-year	50-year	100-year
First Cost	$456,732	$1,528,039	$3,004,739
Operation and maintenance costs	49,000	59,000	91,000
Average annual costs	86,123	183,199	335,225
Average annual benefits	171,800	189,100	282,100
Net benefits	85,677	5,901	-53,125
Benefit-cost ratio	2.00	1.03	0.84

Biological Impacts. - A preliminary evaluation indicates that ring levee construction would have limited impacts on the natural resources in the study area. Aerial color infrared photos taken in 1978 were used to conduct this evaluation. Since the photos did not provide full coverage of the study area, 166 (47 percent) of the farmsteads in the study area were evaluated.

A 7-acre levee enclosure was assumed to be the average levee size, and the types of vegetation that would be affected were determined for each farmstead. Eight percent of the farmsteads had wetlands present, although no wetland was greater than 1 acre. These wetlands were usually stock or farm ponds. Such wetlands would most likely be included within the 7-acre enclosure. Grasslands, present on 89 percent of the farmsteads, were either heavily grazed or residential in nature, and 89 percent of the farmsteads had some type of wooded area, usually in the form of a planted windbreak. Ring levee construction would result in the removal of some trees on 35 percent of the sites evaluated.

Croplands that would be affected fall into the following soil associations in Pembina County: Wahpeton-Cashel Association, Bearden-Colvin Association, and Hegne-Fargo Association. In Walsh County, the

Wahpeton-Cashel-Fargo Association, Bearden-Glydon Association, and Hegne-Fargo Association are present. Many of the sites evaluated are classified as prime farmland by the Soil Conservation Service.

It is recommended that, where possible, wetland areas be included in the levee enclosure to maintain them and the vegetative diversity in the area. It may be possible to use these wetlands as ponding areas for interior drainage. Since wooded vegetation is limited in the study area, it is recommended that the windbreaks be included within the levee enclosures wherever possible.

Cultural Impacts. - A recent cultural resource survey of selected farmsteads in the study area has determined that there is a high probability that sites could be impacted by construction of ring levees depending on the location of the farmstead being protected. Farmsteads located on or near a major tributary of the Red River have the highest probability for the existence of sites. Farmsteads located within 0.5 mile of the Red River main stem have the next highest probability, while farmsteads located away from a major water source on the flat lands of the valley have the lowest probability for the existence of sites. All farmsteads selected for ring levee construction, regardless of their location within the Red River Valley, will be surveyed, as needed, to determine if any archeological sites will be impacted. Those farmsteads, however, that are located within high probability areas will receive first priority in the allocation of resources and manpower for surveys.

It is not anticipated that any structures will be impacted by the construction of ring levees; therefore, there will be no impact to historic standing structures. Additional information on the probability survey is contained in appendix C of this report.

Social Impacts. - This alternative would greatly reduce flood damages on the inhabited operational farmsteads and would improve social well-being by reducing the adverse social impacts that accompany flooding. In

addition, the economic welfare of the region and Nation would be improved with the significant reduction in average annual flood damages.

Recreational Impacts. - Recreation opportunities would not be affected due to construction of ring levees around farmsteads.

Raising Buildings

Description. - Existing farmstead structures in the floodprone study area would be raised-in-place to an elevation of the 100-year flood to reduce the susceptibility of the structure to flood damage. Specifically, this was considered for residences, barns, grain bins, machinery sheds, and garages. However, practically this alternative was evaluated only for residences and grain storage bins. The other structures generally have concrete slab or earth floors with contents such as farm machinery which is movable. In addition, structures on concrete slabs cannot be moved without special equipment or additional expense not warranted in this case. For residences, this would involve disconnecting and connecting plumbing, wiring, and utilities, and extending foundation walls or constructing a new foundation. Since many of the existing farmstead residences have stone foundations, raising the home would generally involve replacement of the old foundation with a new concrete foundation.

Residential structures have been raised satisfactorily up to 9 feet; however, in this study 6 feet is the maximum raise required to move the farm residence out of the floodplain. On the average, a 2-1/2-foot raise is required and would be acceptable based on overall structural stability of the buildings and the aesthetics associated with the farmstead area. In total, 205 residences and 845 grain storage bins were considered for raising under this alternative.

Benefits and Costs. - The basic cost items to raise a structure in-place include bracing, jacking, and resetting the structure; extending and reconnecting utilities; reconstructing foundations and entryways; and

relandscaping. Cost estimates were based on an average cost per square foot of structure. Raising a structure reduces damage caused by flood events below the raised first floor elevation. Residual damage still remains for flood events above the raised first floor elevation and some minor damage may occur to the underside of the first flood floor.

This alternative is feasible in all floodplains. A summary of the costs and benefits for this alternative is shown in the table below.

Benefits and Costs for Raising Farmstead Buildings

Item	20-year	50-year	100-year
First Costs	$750,972	$886,799	$1,349,459
Operation and maintenance costs	49,000	59,000	91,000
Average annual costs	110,039	131,079	200,864
Average annual benefits	140,876	155,062	231,322
Net benefits	30,837	23,883	30,458
Benefit-cost ratio	1.28	1.18	1.15

Biological Impacts. - Raising buildings would not affect the natural resources in the study area except for minor disruptions during the actual raising of buildings. Relandscaping should repair the site to original conditions.

Cultural Impacts. - A preliminary survey of selected farmsteads within the study area has resulted in the location of two potentially significant historic standing structures. Future surveys may identify additional structures. All structures that may be raised that are determined eligible for inclusion on the National Register of Historic Places will be altered only if it can be accomplished in a historically significant manner. Such proposed alternatives will be coordinated with the Advisory Council on Historic Preservation.

Social Impacts. - This alternative offers the advantage of safeguarding the farmstead residents' property during a flood but, at the same time, the social acceptability of such actions may be limited. Further coordination with affected interests would be required to fully define social impacts of this alternative.

Recreational Impacts. - Recreation opportunities would not be lost due to raising of buildings as a method of flood damage reduction.

Floodproofing

Description. - Floodproofing involves making houses secure from floodwater intrusion by providing the house with a water-tight seal. This seal would not permit the admission of floodwaters. In most cases, a water-tight basement wall would be constructed which has enough structural integrity to withstand the hydrostatic forces generated by floodwaters. Water-tight openings (doors and windows) and walls would be sealed or filled in to prevent floodwaters from reaching the interior of the house. Such closures may be temporary or permanent. Temporary closures are installed only during a flood threat and therefore need warning time for installation. For the study area, generally 1 to 2 weeks warning time is available prior to a flood occurrence. This would be sufficient time to undertake specific floodproofing measures. Temporary or permanent measures include installing rubber type gaskets; providing flood shields; replacing window glass with plexiglass or glass block; using concrete, blocks, bricks, and other impermeable materials; and applying sealants.

This alternative was considered for each type of farm building. Principal considerations were that (1) the exterior walls are already impermeable or can be made so, (2) all openings below the 100-year flood level can be closed, and (3) the structure can withstand the anticipated hydrostatic pressures including buoyancy. Since almost all of the floodplain structures are made of wood, aluminum, sheet metal, or other

permeable materials, implementation of this alternative would be difficult, if not impossible. Therefore, after further consideration of the physical nature and use of the structures, this alternative was evaluated only for residences and grain storage bins. In all, this included 205 residences and 845 grain storage bins.

<u>Benefits and Costs</u>. - To make the residential and grain storage bins impermeable and able to withstand the pressures anticipated is costly. Costs were evaluated based on an average cost per square foot of structure, while benefits were identified using flood damages reduced up to and including the 100-year flood level. On a floodplain basis, floodproofing is not a feasible alternative. A summary of the costs and benefits for this alternative is shown in the table below.

Benefits and Costs for Floodproofing Alternative

Item	20-year	50-year	100-year
First Costs	$1,524,800	$1,836,000	$2,832,000
Operation and maintenance costs	49,000	59,000	91,000
Average annual costs	172,935	208,230	321,185
Average annual benefits	140,876	155,062	231,322
Net benefits	-32,059	-53,168	-89,863
Benefit-cost ratio	0.81	0.74	0.72

<u>Biological Impacts</u>. - Floodproofing would not affect the natural resources in the study area.

<u>Cultural Impacts</u>. - A preliminary survey of selected farmsteads within the study area has resulted in the location of two potentially significant historic standing structures. Future surveys may identify additional structures. All structures that may be floodproofed that are determined to be eligible for inclusion on the National Register of Historic Places will be altered only if it can be accomplished in a historically significant manner. Such proposed alternatives will be coordinated with the Advisory Council on Historic Preservation.

Social Impacts. - Floodproofing offers a degree of flood protection that approaches that of farmstead ring levees and raising buildings. This method will also safeguard farmstead property and will reduce adverse social impacts that accompany flooding. However, such physical protection may create a false sense of security and induce people to stay in the structure longer than they should. Therefore, evacuation of the floodplain residents during particular flood events would be an important feature of implementation of this alternative. This, naturally, would limit the social acceptability of this alternative.

Recreational Impacts. - Recreation opportunities would not be lost due to floodproofing of farmstead buildings.

Flood Forecast, Warning, and Evacuation

Description. - Flood forecast, warning, and evacuation is a strategy used to respond to a flood threat by recognizing early the flood potential, making arrangements for the evacuation of people from the flooded area, and making provisions for postflood reoccupation of the flooded area. This alternative is important and should be considered in rural areas.

Flood warning is a critical link between forecast and response (evacuation). To be effective, the warning process should disseminate information at designated times on the flood potential and be followed by an effective response. Such a response would include establishment of action teams; identification of rescue and emergency equipment which can be utilized; identification of priorities for evacuation, maintenance, and management of vital services during the event; and postflood reoccupation and recovery. Practically, for rural areas, a plan should be developed and implemented on a county-wide basis. For the study area, the National Weather Service is responsible for early recognition and evaluation of potential floods. Initially, forecasts are published about 2 months ahead of an impending flood. These forecasts are then updated

regularly. Such a forecast system provides residents of the study area with ample time to implement a warning and evacuation response.

Benefits and Costs. - Costs vary widely with the extent and detail of effective warning and response actions. These costs are difficult to measure because of the many variables, and therefore are not identified herein. Likewise, the benefits are not measured because they relate to the saving of lives, the creation of cohesion among floodplain residents, and other social factors.

Biological Impacts. - Forecasting, warning, and evacuation of the farmstead residents will not result in any disturbance to the natural resources in the study area.

Cultural Impacts. - Implementation of this alternative will have no impact on the cultural resources of the area.

Social Impacts. - Emergency evacuation is one of the best methods of safeguarding the lives of people during a flood emergency inasmuch as farmstead occupants are removed from the flooded area. However, this alternative provides no reduction of adverse social impacts which occur as a result of flood damage to farmstead buildings and economic loss to the region and Nation.

Recreational Impacts. - Recreation opportunities would not be lost as a result of implementing this alternative.

EVALUATION OF ALTERNATIVES

The purpose of this evaluation is to identify the alternatives that best satisfy the study objectives and are worthy of further consideration. The effectiveness, acceptability, completeness, and efficiency of each

alternative were considered. The subsequent paragraphs briefly discuss the results of the evaluation used to identify alternatives recommended for further study.

All of the nonstructural alternatives offer the potential to reduce flood damages and/or flood losses in the study area. However, none of the alternatives can eliminate flood damages by themselves. Even if the alternatives were combined with other structural or nonstructural solutions, the flood problems remain in the agricultural area. Protection of the real property (small farm business) by nonstructural solutions appears to be the most positive step that could be taken to reduce flood damages along the lower portion of the Red River main stem.

Of the alternatives considered, both ring levees and raising buildings are cost effective nonstructural solutions for floodplain farmsteads in the study area. Specifically, ring levees were determined to be economically justified in the 20- and 50-year floodplains, providing protection for 98 and 18 farmsteads, respectively. However, the same alternative lacked economic feasibility for the 64 farmsteads located in the 100-year floodplain. Raising structures above flood levels was found to be economically feasible in all floodplains. Potentially, a combination of these nonstructural solutions could best satisfy the national economic development objective. Economically, floodproofing was not considered feasible because of the high initial costs and the physical impracticality of implementing such a solution. Also, flood forecasting, warning, and evacuation is not a viable alternative by itself because it does not reduce average annual damages; however, it is appropriate from a social well-being aspect as it does reduce the potential for loss of life during a particular flood event. From that standpoint, it should be used either with or without a flood damage reduction plan. Therefore, this alternative is considered an important element of the base condition.

Health and safety requirements are important when evaluating the considered alternatives. Health requirements include the maintenance of sanitary, water supply, and heating facilities during a particular flood event. At present, septic systems provide the necessary sanitary facilities. Seepage is not a problem to existing facilities because of the impervious soil conditions. The sanitary facilities would not be affected further due to implementation of the identified alternatives. Also, livestock is not present and therefore no additional sanitary requirements are needed. Water supply is provided by the rural water distribution system. This system is a pipeline system which is designed to function adequately either with or without flood events. No contamination of drinking water is expected and therefore maintaining a consistent water supply is not a problem. Heating facilities are generally provided by oil furnaces located at the farmstead residence. Implementation of any of the alternatives would not affect functioning of this facility.

Safety requirements include flood warning systems, type of flooding, vulnerability of levees to overtopping, and isolation of farmsteads during flood events. As previously discussed, the flood forecasting and flood warning system used in the Red River Valley is a well-defined cooperative effort between many interests. At a minimum, farmstead residents in the study area will have approximately 2 weeks of advanced warning of an impending flood disaster. Given the predicted magnitude of flooding, this is ample time for residents to take the steps necessary to provide for adequate safety.

The type of flooding also does not increase the requirements for safety. Flooding on the Red River is characterized by slow-rising rivers which escape the narrow channels and spread out over the valley in slow-moving sheets. Thus, the type of flooding combined with the existing flood warning system is not a threat to floodplain residents.

The vulnerability of farmstead levees being overtopped is another safety aspect. Currently, the ring levee alternative would require farmstead levees to be designed to provide protection for the 1-percent chance flood with 3 feet of freeboard. Such a freeboard allowance would provide a margin of safety above the design flood level.

Isolation of floodplain farmsteads could occur with or without a project. To assure that the loss of life potential remains at a minimum during isolation events, a temporary evacuation plan should be utilized. Practically, such an evacuation plan would not be limited to isolation events but rather it should apply to any farmstead when specific safety requirements are violated or when flood events are predicted to exceed the design flood level. Consideration will be given to further define this action in the remaining studies.

Preliminary evaluation indicates that none of the alternatives investigated would significantly impact the biological, cultural, social, or recreational resources of the study area. Future studies will focus on the development of general guidelines for levee alignment, construction, and design in order to keep all adverse impacts to a minimum and potentially improve resource opportunities.

As specified by Section 122 of the 1970 Rivers and Harbors Act, the following categories of impacts were considered and found to be not significant for this project at this time: noise, aesthetic values, tax revenues, property values, public facilities, public services, employment, business and industrial activity, displacement of farms, air quality, and water quality.

In summary, the alternatives worthy of additional study are listed below:

1. Ring levees for farmsteads.
2. Raising farmstead buildings.

COST SHARING

Section 73 of Public Law 93-251 requires that nonstructural solutions be considered in all flood control studies. This section also indicates that local costs for nonstructural flood damage reduction measures should not exceed 20 percent of the total cost. Present policy guidance indicates that floodproofing with small ring levees or walls is considered to be a nonstructural measure. As with any nonstructural measure (relocation of homes and businesses, floodproofing, etc.), the primary beneficiaries are easily identifiable. However, for the study area, the impact of these benefits is widespread as they benefit the general public as well as the individual landowner. The operation of the farms in the study area is critical to the economic and social well-being of the region and the Nation. On the basin-wide level, damages to farmsteads constitute a significant portion (about 14 percent) of the total average annual damages. Thus, reduction of these damages would have a significant impact on the basin. From a national standpoint, the Red River Valley is important to the Nation's agricultural production total, to which the valley contributes significantly. Much of the contribution comes from the floodplain farmers. Because of the widespread nature of the benefits and the requirements of Public Law 93-251, 80-percent Federal and 20-percent local cost sharing will be used.

NON-FEDERAL RESPONSIBILITIES

For the alternatives identified herein, the non-Federal participation is 20 percent of that measure's costs allocated to flood damage reduction pursuant to the requirements for nonstructural projects outlined in Section 73 of Public Law 93-251. Operation and maintenance costs are the responsibility of the local sponsor.

The contract between the Corps of Engineers and the local sponsor will clearly fix the responsibility for assuring satisfactory operation and

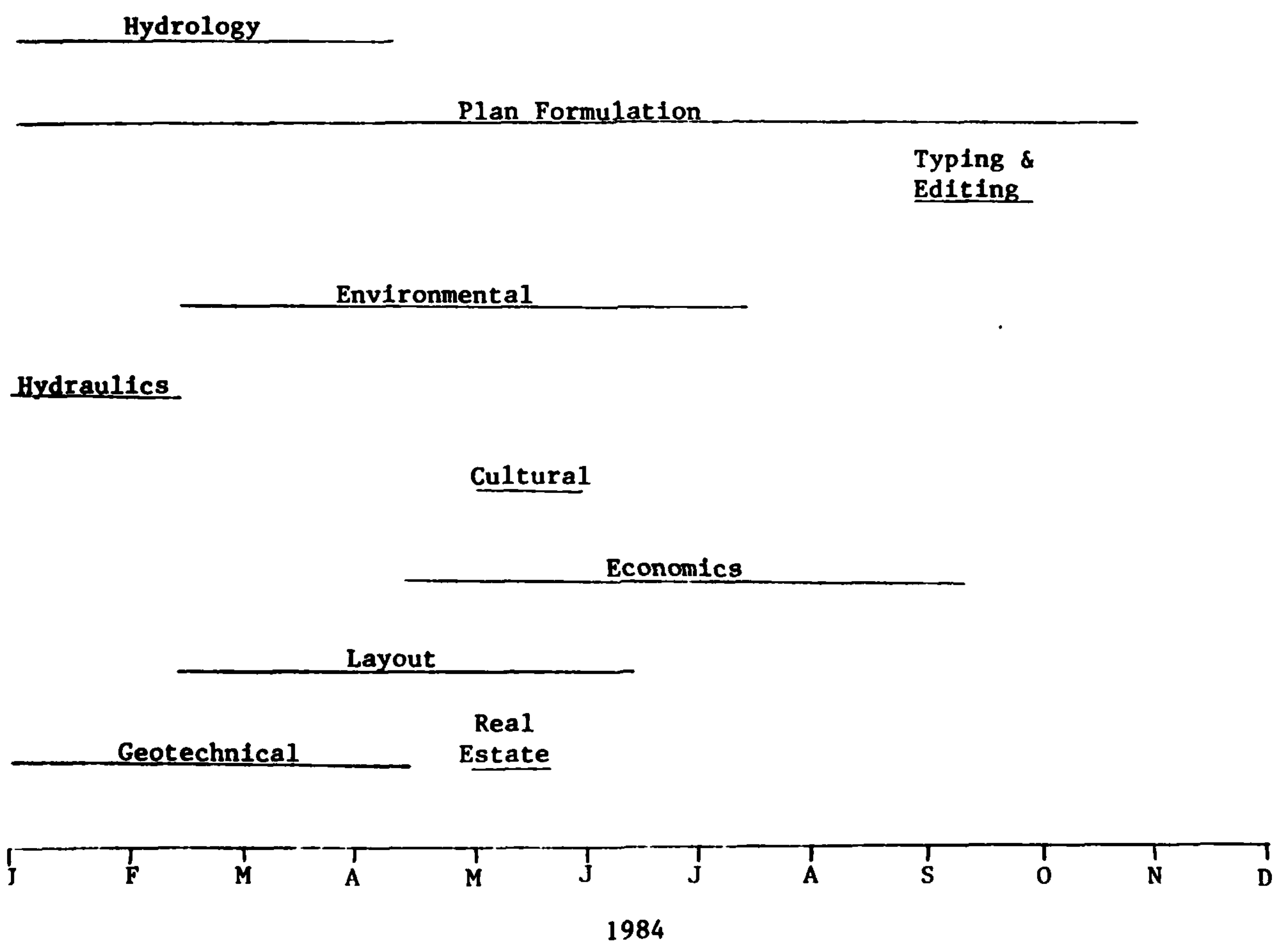
maintenance of installed ring levees or raising building measures. In general, all project features will be maintained to the required shape and height. Erosion-controlling vegetation will be maintained and woody vegetation which may become established on the levee will be periodically removed. Interior drainage facilities will also be kept operational.

The final feasibility report must include a letter of intent from properly authorized non-Federal public agency stating its ability and willingness to cooperate. Because of the nature of the flood problem and the lack of other solutions impacting on flood levels in the study area, the county may be an appropriate local sponsor.

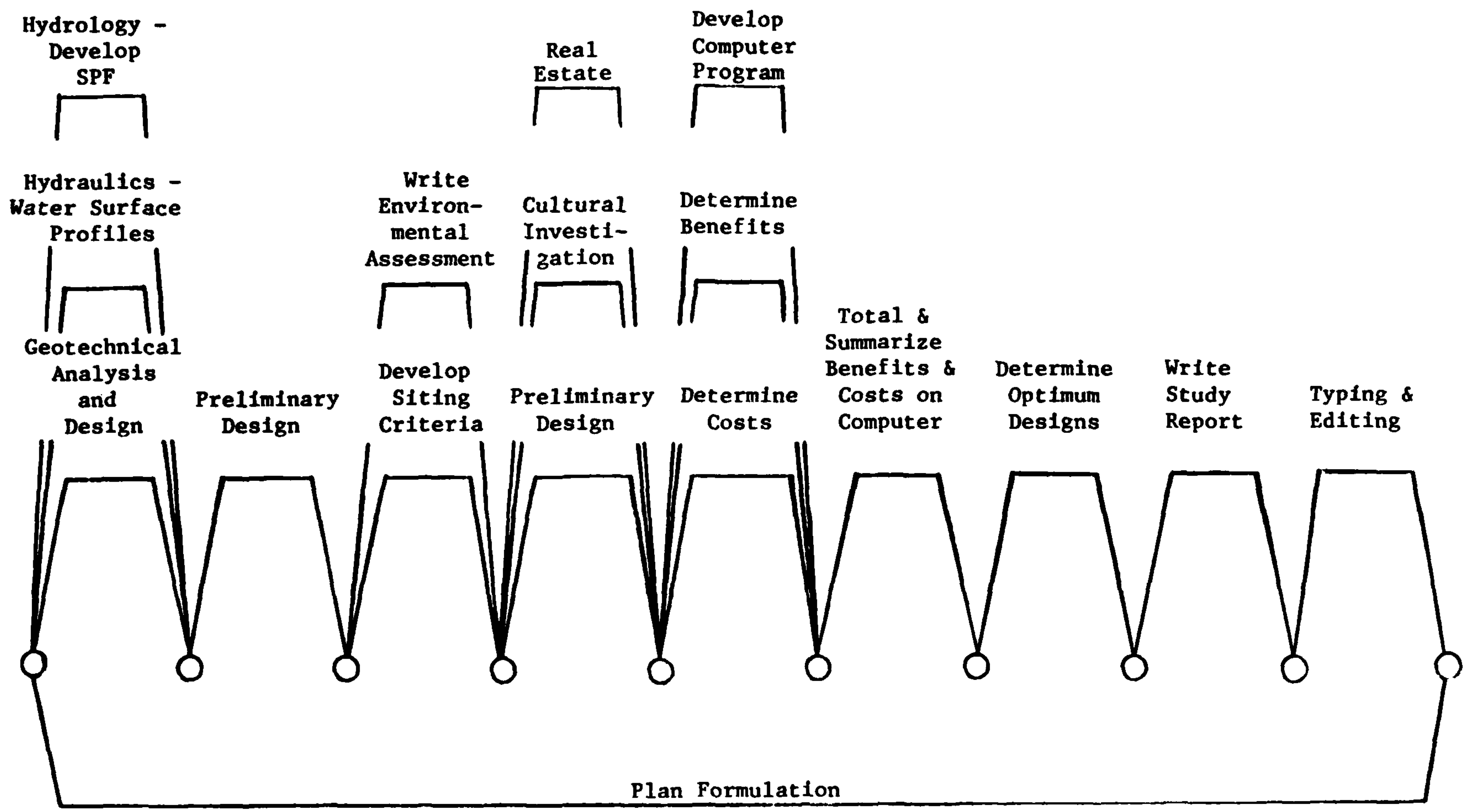
REMAINING WORK

This section establishes the specific work tasks necessary to complete the feasibility study. These tasks are identified by functional area. Also, a time line and flow chart are included for better understanding of the overall relationship of work tasks.

Red River of the North
Farmstead Ring Levees
Time Line



Red River of the North
Farmstead Ring Levees
Flow Chart



Future studies include the preparation of working papers followed by the preparation of a feasibility report.

The working papers will focus in more detail on all nonstructural alternatives for rural flood damage reduction in the study area and will consist of a more detailed evaluation of the recommended alternatives investigated in the reconnaissance report. The alternatives will be screened, and the selection of one alternative or a combination of alternatives will be made.

The feasibility report will recommend one plan for development of plans and specifications.

BACKGROUND INFORMATION AND BASIC DATA

A major portion of the economic, environmental, and surveying background information and basic data has been gathered. It is anticipated that little additional information will need to be acquired.

HYDROLOGIC AND HYDRAULIC STUDIES

Discharge-frequency curves and rating curves have been developed for several gaging stations along the river in the study area. Standard project flood determination will be accomplished during preparation of the working papers.

ECONOMIC STUDIES

After this reconnaissance report, the next step in the study process, i.e., working papers, requires that more detailed benefits and costs be determined. Water surface profiles along with surveying data will be used to determine floodwater depth from which damages to each farmstead's buildings, grain, and machinery can be inferred.

After geotechnical analysis and design have been accomplished, costs of protection can be determined. Geotechnical analysis will help to better define the various flood damage reduction measures which may be appropriate for any given farmstead. Once the methods of flood damage reduction are investigated for each farmstead, costs for protection can be determined.

The next step in the economic evaluation of the farmsteads is to modify computer programs to identify benefits and residual damages for each farmstead and each alternative.

Once these tasks are complete, optimal flood damage reduction design can be selected for each farmstead floodplain.

REAL ESTATE STUDIES

Preliminary real estate appraisals will be made for project formulation. Estimates will take into account the acquisition costs for lands and damages, relocation assistance payments, and administrative costs.

DESIGN AND COST STUDIES

Preliminary design and cost estimates for various alternatives will be developed. The estimates will include costs of land, rights-of-way, structures, and relocation of roads and utilities. Benefits identified in economic studies will be compared with these costs to determine each alternative's benefit-cost ratio.

GEOTECHNICAL STUDIES

Additional geotechnical information will be gathered and used to identify the general soil conditions and potential foundation problems. Soil borings will be taken and samples tested for a representative farmstead. The test results will be applied to the farmsteads considered to have

soil conditions which may preclude construction of certain types of flood damage reduction alternatives.

ENVIRONMENTAL STUDIES

As the studies progress and more detailed designs of alternatives are developed, more environmental input to the working papers is required. Completion of the working papers will involve the preparation of an environmental assessment. A set of criteria will be developed for identifying and minimizing the impacts that could result from the construction of a particular ring levee. Additional consideration will be given to the requirements of Section 122 of the 1970 Rivers and Harbors Act.

CULTURAL RESOURCE STUDIES

Future cultural resource studies will include additional field surveys at farmsteads located in areas that demonstrate a high probability for the existence of potentially significant prehistoric or historic archeological sites or historic standing structures. For sites located that are determined to be potentially significant, testing to determine eligibility for the National Register of Historic Places will be undertaken. All sites or structures determined to be eligible will be mitigated in accordance with the Advisory Council on Historic Preservation Regulations, 36 CFR 800.

SOCIAL ANALYSIS STUDIES

Social studies performed during preparation of the working papers will better develop the base conditions and assist in developing a preliminary impact assessment of proposed measures and plans. The acceptability of the various flood damage reduction alternatives to the residents will also be analyzed.

CONCLUSIONS

- There is a significant flood problem in the study area that will most likely continue in the foreseeable future. This problem cannot be alleviated by conventional structural flood damage reduction means. Numerous past and recent studies confirm this fact. The Federal interest has been established.

- Existing and projected damages to farmsteads alone constitute 14 percent of the average annual damages occurring in the basin. This damage is generally caused by spring snowmelt flooding.

- The farmstead in the study area is a small business with a very large capital investment. A good portion of the economy of the Nation and region depends on the success of the Red River Valley farmer. The importance of the area is demonstrated in national agricultural production figures. The basin produces three-fourths of the Nation's sunflowers, one-third of the barley, one-fourth of the sugar beets, one-fifth of the flax, and one-tenth of all the wheat, oats, and potatoes. Most farmsteads store crops in grain storage bins on the farmstead site.

- Local and State interests have requested assistance in developing nonstructural solutions for farmstead such as ring levees and raising buildings. Such an effort is fully compatible with anticipated future flood control efforts in the basin.

- Of the flood damage reduction alternatives investigated in Walsh and Pembina Counties, ring levees and raising buildings at farmsteads were found to be economically feasible. In addition, the associated biological, cultural, social, and recreational impacts would be minimal with implementation of either alternative. The cost sharing

of the nonstructural alternative is 80-percent Federal and 20-percent non-Federal. Operation and maintenance would be a non-Federal responsibility.

- There do not appear to be any significant health, safety, or other requirements that would affect implementation of the feasible alternatives.

- Implementation of either of the nonstructural alternatives would have very little adverse effect on flood stages. Experience with large Federal ring levee projects in the general vicinity confirms this.

- The advantages of the feasible alternatives include improved economics of the region and the Nation, social well-being of the floodplain residents, low cost of implementing the solution, significant reduction in average annual flood damages, and no transfer of the flood problem to other areas of the basin.

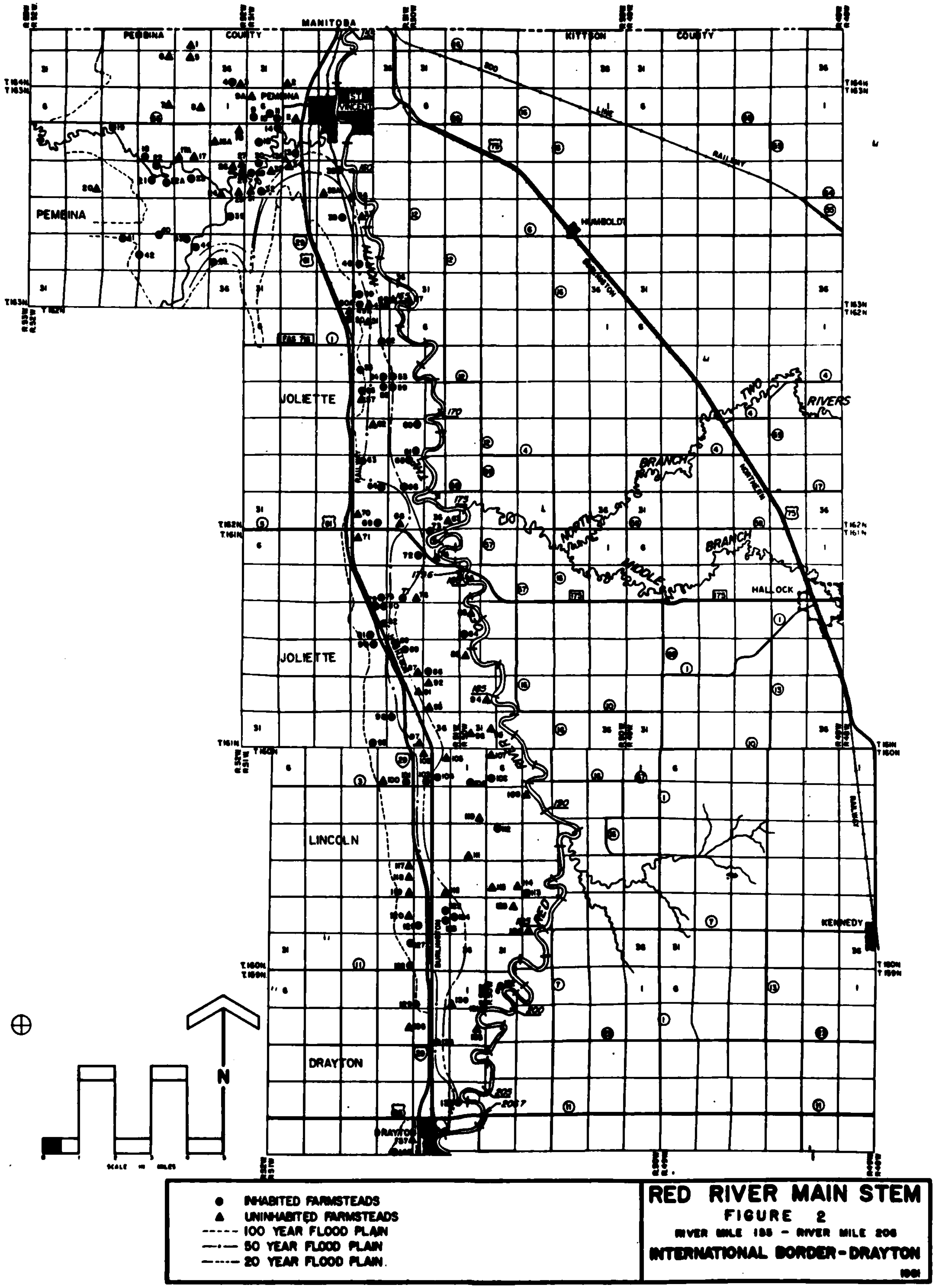
- Implementation of the economically feasible nonstructural alternatives is consistent with similar programs of the Canadian Government and the Soil Conservation Service. Agreements have been reached with the SCS and State of North Dakota so that no duplication of effort will occur.

- Farmstead ring levees considered in this report are relatively uncomplicated structures. They lend themselves to standardized design and construction techniques not requiring detailed investigation normally associated with major flood control proposals.

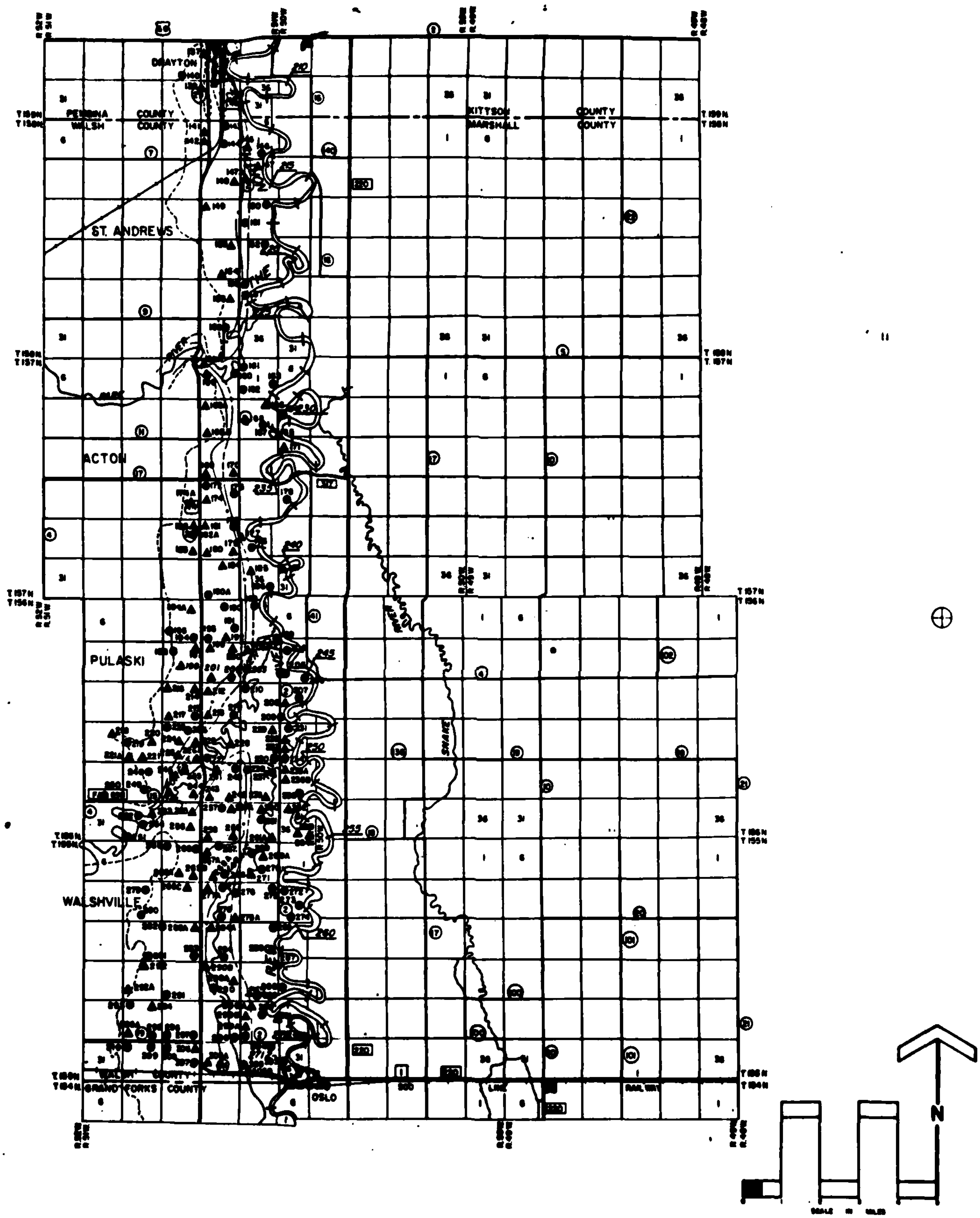
RECOMMENDATION

I recommend that a feasibility study be completed to determine the implementable flood damage reduction measures for farmsteads in Walsh and Pembina Counties, North Dakota, that are in the public interest. This feasiblity study should be accomplished in sufficient detail so that the project could proceed directly to plans, specifications, and construction at the earliest possible date.

Edward G. Rapp
Colonel, Corps of Engineers
District Engineer



MANITOBA
PEMBINA
COUNTY
KITTSON
COUNTY
PEMBINA
ST. VINCENT
HUMBOLDT
JOLIETTE
JOLIETTE
LINCOLN
DRAYTON
HALLOCK
KENNEDY
TWO
RIVERS
NORTH
BRANCH
MIDDLE
BRANCH
RED
N
INHABITED FARMSTEADS
UNINHABITED FARMSTEADS
100 YEAR FLOOD PLAIN
50 YEAR FLOOD PLAIN
20 YEAR FLOOD PLAIN.
RED RIVER MAIN STEM
FIGURE 2
RIVER MILE 155 - RIVER MILE 206
INTERNATIONAL BORDER - DRAYTON



- ● INHABITED FARMSTEADS
- ▲ UNINHABITED FARMSTEADS
- ----- 100 YEAR FLOOD PLAIN
- —·— 50 YEAR FLOOD PLAIN
- ------ 20 YEAR FLOOD PLAIN

RED RIVER MAIN STEM

FIGURE 3

RIVER MILE 206 - RIVER MILE 271

DRAYTON - OSLO

1981

APPENDIX A

CONGRESSIONAL AUTHORIZATIONS

RECONNAISSANCE REPORT
FARMSTEAD RING LEVEE STUDY
RED RIVER OF THE NORTH
WALSH AND PEMBINA COUNTIES, NORTH DAKOTA

APPENDIX A
CONGRESSIONAL AUTHORIZATIONS

The authorities for this study are contained in the following resolutions:

Resolution of House Committee on Public Works, 15 March 1949

". . .to review the reports. . .on the Red River of the North Drainage Basin. . .dated May 24, 1948, and prior reports, with a view to determining if the recommendations contained therein should be modified in any way at the present time, with particular reference to the main stem of the Red River and its tributaries, in the States of Minnesota and North Dakota, between the cities of East Grand Forks, Minnesota, and Grand Forks, North Dakota, and the United States-Canadian Boundary, in the interest of flood control and allied purposes."

Resolution of Senate Committee on Public Works, 15 June 1950

". . .to review the reports on the Red River of the North,. . . submitted in House Document Numbered 185, Eighty-first Congress, and prior reports, with a view to determining if the recommendations contained therein should be modified at this time in view of the disastrous floods of April and May 1950, and in view of the international aspects of the flood problems on which much

information may be obtained from Dominion, provincial, municipal and other interests in Canada through the investigations already under way in accordance with Article IX of the Boundary Waters Treaty of January 1909."

Resolution of House Committee on Public Works, 27 June 1950

". . .to review the reports on the Red River of the North Drainage Basin. . .submitted in House Document No. 185, 81st Congress, 1st Session, and prior reports, with a view to determining whether the recommendations contained therein should be modified in any way at this time."

Resolution of House Committee on Public Works, 19 July 1950

". . .to review the reports on the Red River of the North Drainage Basin. . .submitted in House Document No. 185, 81st Congress, 1st Session, and prior reports, with a view to determining if the recommendations contained therein should be modified at this time in view of the disastrous floods of April and May, 1950, and in view of the international aspects of the flood problem on which much information may be obtained from Dominion, provincial, municipal and other interests in Canada through the investigations already under way in accordance with Article IX of the Boundary Waters Treaty of January 1909."

Resolution of House Committee on Public Works, 19 July 1950

". . .to review the reports on the Red River of the North Drainage Basin. . .submitted in House Document No. 185, 81st Congress, 1st Session, and prior reports, with a view to determining whether the recommendations contained therein should be modified in any way at this time, particularly with reference to improvements for flood control on the Buffalo River, Minnesota."

Resolution of House Committee on Public Works, 19 July 1950

". . .to review the reports on the Red River of the North Drainage Basin. . .submitted in House Document No. 185, 81st Congress, 1st Session, and prior reports, with a view to determining whether the recommendations contained therein should be modified in any way at this time, particularly with reference to feasibility of the construction of a reservoir for flood control and the production of hydroelectric power on Red Lake River, Minnesota, at a point approximately three air-miles west of Red Lake Falls, Minnesota, in the vicinity of Huot or Cyr Rapids."

Resolution of House Committee on Public Works, 16 August 1950

". . .to review the reports on Red Lake River and tributaries... submitted in House Document No. 345, 78th Congress, 1st Session, and subsequent reports, with a view to determining whether the recommendations contained therein should be modified in any way at this time, with particular reference to the feasibility of constructing drainage canals running along, or parallel to, the western boundary of Red Lake Indian Reservation and terminating at Red Lake River, Minnesota."

Resolution of House Committee on Public Works, 16 March 1954

". . .to review the reports on Red Lake River. . .contained in House Document Numbered 345, Seventy-eighth Congress, first session, with a view to determining if it is advisable to modify the existing project in any way at this time."

Resolution of Senate Committee on Public Works, 22 June 1961

". . .to review the report of the Chief of Engineers on the Red River of the North Drainage Basin. . .published as House Document numbered 185, Eighty-first Congress, first session, with a view to determining the advisability of modifying the recommendations contained therein at the present time, with particular reference to providing improvements in the interest of flood control and related purposes in the Goose River Watershed, North Dakota."

Resolution of House Committee on Public Works, 19 June 1963

". . .to review the reports on the Red Lake River and Tributaries, including Clearwater River, Minnesota, published in House Document Numbered 345, 78th Congress, and other pertinent reports with a view to determining the need for further development of the water and related land resources of the basin."

Resolution of House Committee on Public Works, 5 October 1966

". . .to review the reports on the Red River of the North Drainage Basin. . .submitted in House Document No. 185, 81st Congress, First Session, and other pertinent reports, with a view to determining whether the recommendations contained therein should be modified in any way at this time with particular reference to additional improvements for flood control at Grand Forks, North Dakota."

Resolution of Senate Committee on Public Works, 12 July 1973

". . .to review the reports on the Red River of the North, Minnesota and North Dakota, submitted in House Document Numbered 185, Eighty-first Congress, and prior reports, with a view to determining if the recommendations contained therein should be modified at this time in the interest of providing improvements for flood control and allied purposes on the Forest River, North Dakota."

Resolution of Senate Committee on Public Works, 30 September 1974

". . .to review reports on the Red River of the North Drainage Basin,. . .submitted in House Document Numbered 185, 81st Congress, 1st Session, and prior reports, with a view to determining if the recommendations contained therein should be modified at this time, with particular reference to flood control, water supply, waste water management and allied purposes."

APPENDIX B

FARMSTEAD RING LEVEE WORK OF OTHERS

AND

STUDIES AND PROJECTS OF THE CORPS OF ENGINEERS

RECONNAISSANCE REPORT
FARMSTEAD RING LEVEE STUDY
RED RIVER OF THE NORTH
WALSH AND PEMBINA COUNTIES, NORTH DAKOTA

APPENDIX B
FARMSTEAD RING LEVEE WORK OF OTHERS

This appendix presents information on the Soil Conservation Service (SCS) and Canadian Government farmstead ring levee programs in Grand Forks County, North Dakota, and Manitoba, Canada, respectively. Also included is a discussion, with maps, of completed projects and ongoing studies of the Corps of Engineers. Part 1 presents SCS North Dakota guidelines for planning nonstructural measures in the Red River of the North. Also included are standards and specifications for construction of SCS farmstead ring levees. Part 2 includes a summary of "The Canada-Manitoba Moving, Raising, Dyking Program in the Red River Valley." This summary describes the administrative setup and approach utilized by Manitoba for implementation of this program. Part 3 provides a summary of prior reports, history of existing projects and ongoing studies of the Corps of Engineers in the Red River basin.

APPENDIX B

FARMSTEAD RING LEVEE WORK OF OTHERS
AND
STUDIES AND PROJECTS OF THE CORPS OF ENGINEERS

SECTION 1

FARMSTEAD RING LEVEE PROGRAMS
SOIL CONSERVATION SERVICE

NORTH DAKOTA GUIDELINES FOR PLANNING NONSTRUCTURAL MEASURES IN THE VALLEY OF THE RED RIVER OF THE NORTH

GENERAL

The interim guidelines for planning nonstructural measures in North Dakota will be used for relocation, floodproofing, flood warning, and flood plain acquisition. Generally, relocation and flood plain acquisition measures are not anticipated. The Red River flood plain and its tributaries have an adequate flood warning system. Floodproofing primarily by dikes is expected to be the principal means of alleviating flood damages. Since dikes for floodproofing individual farmsteads, residences, and/or structures appears to be of major importance, a brief description on classification and design criteria follows.

DIKES FOR FLOODPROOFING

Classification - For the purposes of the Red River flood plain management measure plan, the following will be used for the dike classification:

Class I - Dikes protecting property located in the "high risk zone" as determined by the "Interim Guidelines for Planning Nonstructural Measures in North Dakota" or having estimated average annual flood damages exceeding $5,000.00.

Class II - Dikes protecting property located in the "low risk zone" as determined by the "Interim Guidelines for Planning Nonstructural Measures in North Dakota" with estimated average annual flood damages exceeding $1,500.00.

Design Criteria - Practice Standard Dike (356) in Section IV of the Technical Guide will be used. In 1979 portions of the Red River Valley experienced the flood of record this century. Based on the 1979 flood stages which included wave runup, the following will be used:

Class I - Top elevation will be to the 100-year frequency flood elevation plus 2 feet of freeboard or the 1979 flood elevation plus 1 foot freeboard, whichever is greater.

Class II - Top elevation will be to the 50-year frequency flood elevation plus 2 feet of freeboard or the 1979 flood elevation plus 1 foot freeboard, whichever is greater.

Class III - Top elevation will be to the 10-year frequency flood elevation plus 2 feet of freeboard.

Note: Existing highwalls, roads, and railroads with top elevations equal to or greater than the design high water, if structurally sound, may constitute a segment of the dike system. Freeboard for these segments may not be required if an analysis indicates it is not needed for settlement and protection from wave attack.

Dike (ft)
(SCS Practice 356)

*Indicates a North Dakota supplement.

Definition

An embankment constructed of earth or other suitable materials to protect land against overflow or to regulate water.

Scope

This standard applies to dikes or levees used to prevent or reduce flood damage to land and property, for flow control in conjunction with floodways, or to impound or regulate water for fish and wildlife management.

Dikes are divided into classes determined by the value of the land, crops, and other improvements and the hazard to life within the area to be protected.

Purpose

To permit improvement of agricultural land by preventing overflow and better use of drainage facilities, to prevent damage to land and property, and to facilitate water storage and control in connection with wildlife and other developments. Dikes can also be used to protect natural areas, scenic features, and archeological sites from damage.

*Conditions where practice applies

Class I dikes are those constructed on sites where:

1. Failure may cause loss of life or serious damage to homes, industrial and commercial buildings, important public utilities, main highways or railroads, and high value land, crops, or other improvements.
2. Unusual or complex site conditions require special construction procedures to ensure satisfactory installations.
3. Protection is needed to withstand more than 12 ft (3.7 m) of water above normal ground surface, exclusive of crossings of sloughs, old channels, or low areas.

Class II dikes are those constructed in highly developed and productive agricultural areas where:

1. Failure may damage isolated homes, highways or minor railroads, or cause interruption in service of relatively important public utilities.
2. The maximum design water stage against the dike is 12 ft (3.7 m).

Class III dikes are those constructed in rural or agricultural areas where:

1. Damage likely to occur from dike failure is minimal.
2. The maximum design water stage against the dike is 6 ft (1.8 m) for mineral soils and 4 ft (1.2 m) for organic soils. (Exclude channels, sloughs, swales, and gullies in determining the design water stage.)

* Design criteria—all dikes

In locating dikes, careful considerations shall be given to preserving natural areas, fish and wildlife habitat, woodland, and other environmental resources. If dike construction will adversely affect such values, concerned public agencies and private organizations shall be consulted about the project.

* **Protection.** A protective cover of grasses shall be established on all exposed surfaces of the dike and other disturbed areas. Seedbed preparation, seeding, fertilizing, mulching, and fencing shall comply with recommendations in local technical guides.

If vegetation will not control erosion, riprap or other protective measures shall be installed.

Maintenance. All dikes must be adequately maintained to the required shape and height. The maintenance of dikes must include periodic removal of woody vegetation that may become established on the embankment. Provisions for maintenance access must be provided.

Design criteria—Class I dikes

Location. Conditions to be considered in designing Class I dikes are foundation soils, property lines, exposure to open water, adequate outlets for gravity or pump drainage, and access for construction and maintenance. Mineral soils that will be stable in the dike embankment must be available.

Height. The design height of a dike shall be the design high water depth plus 2 ft (0.6 m) of freeboard or 1 ft (0.3 m) of freeboard plus an allowance for wave height, whichever is greater. Design elevation of high water shall be determined as follows:

1. If dike failure is likely to cause loss of life or extensive high-value crop or property damage, the elevation of design high water shall be that associated with the stage of the 100-year-frequency flood or of the maximum flood of record, whichever is greater.
2. If dike failure is unlikely to result in loss of life or extensive high-value crop or property damage, the elevation of design high water shall be that associated with the peak flow from the storm that will insure the desired level of protection or the 50-year-frequency flood, whichever is greater.
3. If the dike will be subject to stages from more than one stream or source, the criteria indicated shall be met for the combination that causes the highest stage.
4. If the dike will be subject to tidal influence as well as streamflow, the streamflow peak shall be assumed to occur in conjunction with the mean high tide to determine the design high water depth.

The design height of the dike shall be increased by the amount needed to insure that the design top elevation is maintained after settlement. This increase shall be not less than 5 percent.

Interior drainage. If inflow from the area to be protected by the dike may result in loss of life or extensive high-value crop or property damage, provisions shall be included in the plans to provide interior protection against a 100-year-frequency hydrograph, plus base flow, and an allowance for seepage, and may include storage areas, gravity outlets, or pumping plants, alone or in combination.

If inflow from the area to be protected by the dike is unlikely to result in loss of life or extensive high-value crop or property damage, storage areas, gravity outlets, or a pumping plant, alone or in combination, shall be included in the plans and designed to handle the discharge from the drainage area based on drainage requirements established for the local area or the peak flow from the storm that will insure the desired level of protection, whichever is greater.

In sizing outlet works in combination with available storage, the minimum design storm duration for interior drainage shall be 10 days. If outlet works are designed using peak flood frequency flows without considering storage, the minimum design storm duration shall be 24 hours.

Embankment and foundation. The embankment shall be constructed of mineral soils, which when placed and compacted will result in a stable earth fill. No organic soil shall be used in the dike. Soils must have high specific gravity and be capable of being formed into an embankment of low permeability. The design of the embankment and specifications for its construction shall give due consideration to the soil materials available, foundation conditions, and requirements for resisting the action of water on the face of the dike and excessive seepage through the embankment and the foundation. The design of the embankment and the foundation requirements shall be based on the length of time and height that water will stand against the dike.

Minimum requirements for certain features of the embankment, the foundation, and borrow pits are as follows:

Minimum top width of Class I dikes shall be 10 ft (3 m) for embankment heights of 15 ft (4.6 m) or less and 12 ft (3.6 m) for heights more than 15 ft (4.6 m). If maintenance roads are to be established on the dike top, "turnarounds" or passing areas shall be provided, as needed.

Side slopes shall be determined from a stability analysis, except that an unprotected earth slope on the water side shall not be steeper than 4 horizontal to 1 vertical if severe wave action is anticipated.

If dikes cross old channels or have excessively porous fills or poor foundation conditions, the landside toe shall be protected by a banquette or constructed berm. Banquettes shall be used to provide construction access and added stability if channel crossings are under water or saturated during construction. Banquettes shall be designed on the basis of site investigations, laboratory analysis, and compaction methods. The finished top width of the banquettes shall not be less than the height of dike above mean ground. The finished top of the banquettes shall be not less than 1 ft (0.3 m) above mean ground and shall be sloped away from the dike.

A cutoff shall be used if foundation materials are sufficiently pervious to be subject to piping or undermining. The cutoff shall have a bottom width and side slopes adequate to accommodate the equipment to be used for excavation, backfill, and compaction operations. It shall be backfilled with suitable material placed and compacted as required for the earth embankment. If pervious foundations are too deep to be penetrated by a foundation cutoff, a drainage system adequate to insure stability of the dike shall be used.

Ditches and borrow pits

Landside ditches or borrow pits shall be located so the hazard of failure is not increased. Ditches for borrow pits when excavated on the water side of dikes shall be wide and shallow. Plugs, at least 15 ft (4.6 m) in width, shall be left in the ditches at intervals not greater than 400 ft (121.9 m) to form a series of unconnected basins.

Minimum berm widths between the toe of the dike and the edge of the excavated channel or borrow shall be:

Fill height	Minimum berm width
Less than 6 ft (1.8 m)	12 ft (3.7 m)
More than 6 ft (1.8 m)	18 ft (5.5 m)

A drainage system shall be used if necessary to insure the safety of a dike. Toe drains, if used, shall be located on the landside and shall have a graded sand-gravel filter designed to prevent movement of the foundation material into the drain.

Subsurface drains shall not be installed, or permitted to remain without protection, closer to the landside toe of a dike than a distance three times the design water height for the dike. If subsurface drains are to be installed or remain closer than the distance stated, protection shall consist of a graded sand-gravel filter, as for a toe drain, or a closed pipe laid within the specified distances from the dike.

Pipes and conduits. Dikes shall be protected from scour at pump intakes and discharge locations by appropriate structural measures. A pump discharge pipe through a dike shall be installed above design high water, if feasible, or be equipped with antiseep collars.

All conduits through a dike below the design high waterline shall be equipped with antiseep collars designed to increase the distance of the seepage line along the conduit by at least 15 percent. Discharge conduits of pumps placed below the designed water line shall be equipped with a Dayton or a similar coupling to prevent vibration of the pumping plant being transmitted to the discharge conduits.

Design criteria—Class II dikes

Design water stage. The maximum design water stage permitted is 12 ft (3.7 m) above normal ground level exclusive of crossings at channels, sloughs, and gullies.

If the design water depth against dikes, based on the required level of protection, exceeds 4 ft (1.2 m) the design shall be based on at least a 25-year-frequency flood. If this degree of protection is not feasible, the design shall approach the 25-year flood level as nearly as possible, and planned fuse plug sections and other relief measures shall be installed where appropriate.

Height. The design height of an earth dike shall be the design water depth plus a freeboard of at least 2 ft (0.6 m) or freeboard of 1 ft (0.1 m) plus an allowance for wave height, whichever is greater.

The constructed height of the dike shall be the design height plus an allowance for settlement necessary to insure that the design top elevation is maintained but shall be no less than 5 percent of the design height.

Interior drainage. Provisions must be made for adequate drainage for the area to be protected by the dike.

* **Cross section.** The minimum requirements for the cross section of the dike where fill is compacted by hauling or special equipment shall be as follows:

Design water height		Minimum top width		Steepest side slope
ft	*m*	*ft*	*m*	
0-6	(0-1.8)	6	(1.8)	1-1/2:1
6-12	(1.8-3.7)	8	(2.4)	2:1

If soils or water conditions make it impractical to compact the dike with hauling or special equipment, dumped fill may be used and shall have minimum cross section dimensions incorporated in the fill as follows:

Design water height		Minimum top width		Steepest side slope
ft	*m*	*ft*	*m*	
0-6	(0-1.8)	8	(2.4)	2:1
6-12	(1.8-3.7)	10	(3)	2-1/2:1

Side slopes of 3 horizontal to 1 vertical on waterside and 2:1 on landside may be used instead of 2-1/2:1 for both slopes.

The cross sections shall be strengthened or increased as required to provide additional protection against floods of long duration. The top width shall be not less than 10 ft (3 m) if a maintenance road is planned on top the dike. "Turnarounds" or passing areas shall be provided as required on long dikes.

The side slopes shall be 3:1 or flatter on the waterside if severe wave action is expected or if a steeper slope would be unstable under rapid drawdown conditions. Side slopes shall be 3:1 or flatter on both sides where permeable soils of low plasticity, such as SM and ML, are used in construction.

A banquette (or constructed berm) shall reinforce the landside toe if a dike crosses an old channel or if excessively porous fill or poor foundation conditions justify such reinforcement. Such banquettes shall be used if, during construction, the channel crossing is under water or saturated. The top width of the banquette shall be equal to or greater than the fill height of the dike above the top of the banquette unless a detailed investigation and analyses show a different design is adequate.

Foundation cutoff. A cutoff shall be installed if there are layers of permeable soils or layers creating a piping hazard through the foundation at a depth less than the design water depth of the dike below natural ground level. The cutoff trench shall be of sufficient depth and width and filled with suitable soils to minimize such hazard.

Ditches and borrow pits. Minimum berm widths between the toe of the dike and the edge of the excavated channel or borrow shall be:

Fill height	Minimum berm width
Less than 6 ft (1.8 m)	10 ft (3 m)
More than 6 ft (1.8 m)	15 ft (4.6 m)

A landside ditch or borrow pit shall be far enough away from the dike to minimize any hazard to the dike because of piping through the foundation.

For dikes having a design water depth of more than 5 ft (1.5 m), the landside ditch or borrow pit shall be far enough away from the dike so that a line drawn between the point of intersection of the design waterline with the waterside of the dike and the landside toe of a dike meeting minimum dimensional requirements shall not intersect the ditch or borrow pit cross section.

Pipes and conduits. The dike shall be protected from scour at a pump intake and discharge by appropriate structural measures. A pump discharge pipe through the dike shall be installed above design high water, if feasible, or else equipped with antiseep collars.

All conduits through the dike below the design high waterline shall be equipped with antiseep collars designed to increase the distance of the seepage line along the conduit by at least 15 percent. Discharge conduits of pumps placed below the designed waterline shall be equipped with a Dayton or a similar coupling to prevent vibrations of the pumping plant being transmitted to the discharge conduits.

Drains. Drains shall be used where necessary to insure safety of dikes and shall be located on the land side, have a graded sandgravel filter, and be designed and installed in accordance with Soil Conservation Service standards for such drains.

Field subsurface drains shall not be installed or permitted to remain without protection closer to the landside toe of a dike than a distance three times the design water height for the dike. If such drains are to be installed or remain closer than the distance stated above, protection shall consist of a graded sandgravel filter, as for a toe drain, or a closed pipe laid within the specified distances from the dike.

Design criteria—Class III dikes

The design criteria shall be based on site conditions for mineral or organic soils as applicable.

Top width. Minimum top width is 4 ft (1.2 m).

Side slopes. Minimum side slope is 1:1.

Freeboard. The minimum freeboard is 1 ft (0.3 m) plus wave height. The constructed height shall be increased by the amount necessary to insure that the settled top is at design elevation but not less than 5 percent.

Foundation cutoff. A cutoff shall be installed if necessary to insure dike stability.

Ditches and borrow pits

Minimum berm widths between the toe and the dike and the edge of the excavated channel or borrow shall be two times the depth of the ditch but not less than 8 ft (2.4 m).

Plans and specifications

Plans and specifications for constructing dikes shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

DIKE (FT)
(356)
(North Dakota Supplement)

*Conditions where practice applies.

The design and construction of all flood control dikes, including ring dikes, that will control, divert or impede flows will be in keeping with the "Memorandum of Understanding between the USDA Soil Conservation Service and the North Dakota State Water Commission".

*Design Criteria - All Dikes.

Farmstead ring dikes for flood control in the Red River Valley may be designed and constructed following the "North Dakota Guidelines for Planning Nonstructural Measures in the Valley of the Red River of the North".

*Protection

Establish grass in accordance with Critical Area Planting (342).

*Cross Section

The minimum requirements for the cross section of the dike where fill is compacted by hauling or special equipment shall be as follows:

Compacted Fills

Design Water Height	Minimum Top Width	Steepest Side Slope
Feet	Feet	
0-12	10	2:1

Where soils or water conditions make it impractical to compact the dike with hauling or special equipment, dumped fill may be used and shall have minimum cross section dimensions incorporated within the fill as follows:

Dumped Fills

Design Water Height	Minimum Top Width	Steepest Side Slope
Feet	Feet	
0-12	10	2½:1

APPENDIX B

FARMSTEAD RING LEVEE WORK OF OTHERS
AND
STUDIES AND PROJECTS OF THE CORPS OF ENGINEERS

SECTION 2

FARMSTEAD RING LEVEE PROGRAMS
CANADA-MANITOBA

THE CANADA-MANITOBA
MOVING, RAISING, DYKING PROGRAM
IN THE
RED RIVER VALLEY

D. R. Kimmett
Regional Chief
Water Survey of Canada
Winnipeg, Manitoba

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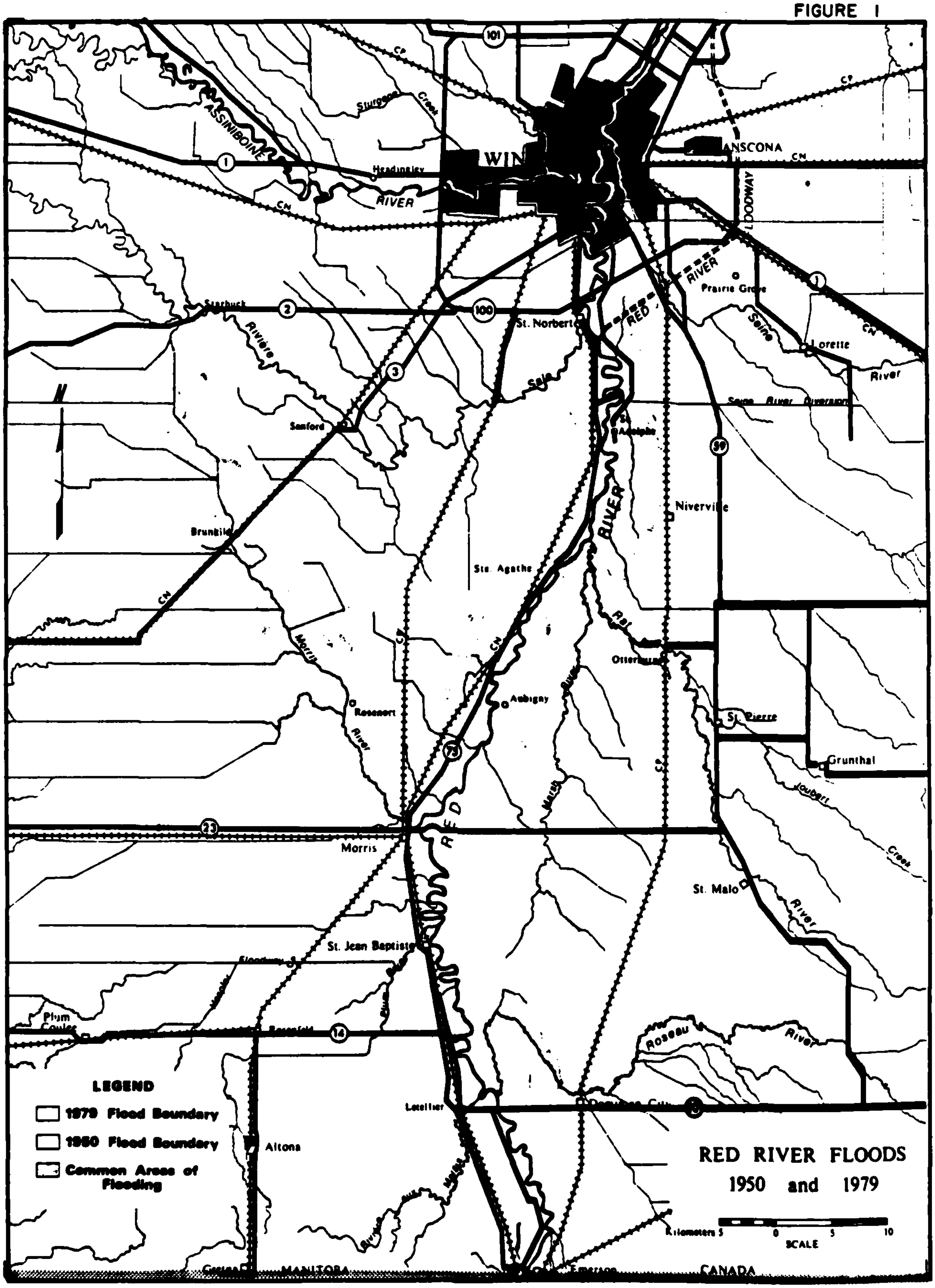
FIGURE 1


RED RIVER FLOODS
1950 and 1979
LEGEND
1979 Flood Boundary
1950 Flood Boundary
Common Areas of Flooding
Kilometers 5 0 5 10
SCALE
ASSINIBOINE
RIVER
Sturgeon Creek
Headingley
TRANSCONA
FLOODWAY
Starbuck
St. Norbert
RED
RIVER
Prairie Grove
Lorette
Seine River
Seine River Diversion
Sanford
Niverville
Brunkild
Ste. Agathe
Otterburne
Aubigny
Rosenort
Morris River
St. Pierre
Grunthal
Joubert Creek
Morris
St. Malo
St. Jean Baptiste
Roseau River
Plum Coulee
Letellier
Altona
MANITOBA
CANADA
Emerson

1.0 Background

Significant spring flooding has been experienced by Red River Valley inhabitants on several occasions throughout recorded history. The cause for flooding lays chiefly with the poor drainage of very flat impervious land with the resulting inability of the main stem to carry winter snowmelt and/or heavy rainfall to its mouth at Lake Winnipeg. The local inhabitants tend to relate the 1979 flood levels to those they have previously experienced such as occurred in 1950, 1966 or 1974. During the 1960's dykes were constructed around the towns of Morris and St. Adolphe, Letellier, Dominion City, St. Jean Baptiste, Rosenort and Emerson in response to this regular flooding problem. In the intervening years some flooding has occurred but has not affected the major portion of the Valley. This regularity of flooding and its adverse effects has resulted in a population that expects flooding every spring. The accompanying emotional and psychological impacts are significant.

The flooded portion of the Valley's economic base is mainly agricultural with a significant portion of the population being of Mennonite and French ancestry.

2.0 Administration of Flood Programs in Manitoba

2.1 General

When flooding is significant, the Province of Manitoba through Order-in-Council creates a Flood Disaster Assistance Board (FDAB). The Board administers a Flood Disaster Assistance Program (DAP) under the terms of a 1970 Federal-Provincial Agreement. The roles and ratio of federal and provincial involvement in the national federal-provincial program is best described by referring to Appendix I obtained from EPC, Winnipeg. Perhaps it is worth noting the DAP costs in Manitoba are separated into three categories for practical purposes and audited accordingly. These may be described as (a) municipal costs (b) flood operations costs and (c) individual claims.

In this instance of flooding (1979) it was decided and authorized in the Order-in-Council (creating the DAP) that in addition to the normal federal-provincial Disaster Assistance Program (DAP) a second program allowing for construction of protective works to mitigate future flood damage would also be implemented. The program involves moving, raising, dyking, etc., of individual realty and will be known in the remainder of this report as the special Moving, Raising, Dyking Program (MRDP).

The FDA Board has responsibility only for the individual claims as noted as item (c) above as well as the special MRDP under discussion here while administration of activities under (a) and (b) above are the overall responsibility of the Manitoba Water Resources Division.

2.2 Flood Disaster Assistance Board (FDAB)

2.2.1 Board Members

The FDA Board is composed of three men who are not only established and well known throughout the Red River Valley but also have a long association and experience with flooding problems in Manitoba. For example, the Chairman of the Board, Mr. Elswood Bole has been chairman of several previous FDA Boards and Mr. Reimer is a member of both Canadian and International Mennonite Disaster Assistance Committees. The third member Mr. Bernard Ayott has held positions with the municipality of Montcalm for over 30 years. Mr. Bole and Mr. Ayott are the most active members of the Board.

2.2.2 Procedures of the Board

The approach that the Board uses to ensure public awareness of the program is to initiate activity and concentrate effort in "pockets" of the valley. As satisfactory progress is being made in one area effort will then be given to initiating another "pocket".

This approach has two beneficial effects; firstly, the visible evidence of construction activity and protective works encourages nearby neighbours to enquire and seek out advice and ultimately to proceed with their own protection measures; secondly, it allows for maximum efficiency and economy of scale for the construction contractors and hence reduces unit costs to homeowner and the Board and ultimately program costs.

I believe for a program of this nature to be successful within the given time and resources constraints the key factor is to obtain the personal commitment of each homeowner. This can be achieved only through effective personal relationships between the Board and the individual. Personal visits by the Board to each family to explain the program, the necessary administrative procedures, the respective responsibilities, recommend specific flood-proofing works and general inspection of completed works is routine procedure for the Board.

This approach has contributed significantly to attaining the personal commitment of the valley's inhabitants.

A major factor contributing to "getting the program going" is the "first visit" recommendation on the specific works applicable to each homestead. Even though newspaper advertisements explain the program the tendency for the homeowner is still to await the verbal "go ahead" by the Board and the verification of the compensation package available.

3.0 Mitigation or Protection Techniques

The Board has deemed two distinct geographical areas to exist when recommending minimum elevations of the protective works. Those protective works south of the south side of the village of St. Adolphe

must be at least 3 feet above the 1979 level while those north of this arbitrary line must be at least 4 feet above the 1979 level.

The 1979 water level is usually retrieved by high water marks on one of the local structures or alternatively the Manitoba Water Resources Division staff survey in the level from known flood elevations outside the property of interest.

The major mitigation structural measures and techniques employed in this MDRP are well described in Appendix II by CMHC engineer, Mr. A. Fraser. This report was prepared at the request of the Director, Emergency Planning Canada, Winnipeg.
One technique Mr. Fraser has not described, however, is the so-called "sidewalk dyke". A plan of this system is also shown in Appendix II and is recommended only in special circumstances usually where space is limited. The "sidewalk dyke" is partly permanent and partly a temporary dyking structure. It is composed of a permanent side-walk with a reinforced concrete footing and curtain with a slot at grade to provide for a plastic covered 3/4 inch four foot by eight foot sheet of plywood. The plywood is then supported by bracing back to the building being protected. This temporary or flood-proofing part (that portion above grade) must be erected just prior to flooding and dismantled after the flood levels have receded. Manpower requirement for this construction is two people although one person could do it with effort. Obvious problems with this method can occur when houses change ownership or when sufficient physical capability or knowledge is not available at the property of interest prior to the time of flooding.

Often due to local topography access to a property it is impractical for a full ring dyke construction. In these instances a gap is normally left in the dyke to allow access and egress. The gap is then sandbagged prior to flooding.

Photographs of several of the actual flood-proofing methods at various stages of completion are shown in Appendix II.

4.0 Administrative and Financial Arrangements

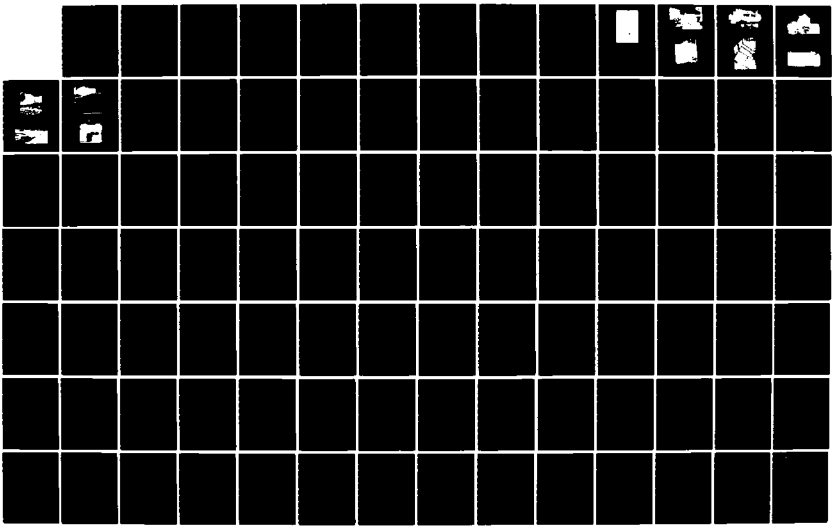
The federal-provincial agreement was initiated through exchange of telexes between Canada and Manitoba on December 18, 1979. Environment Canada agreed to reimburse the Province of Manitoba 50% of their costs for a special flood damage reduction program up to a maximum of $4.25 million. Overall field coordination of the federal portion of the program is the responsibility of Emergency Planning Canada, located in Winnipeg.

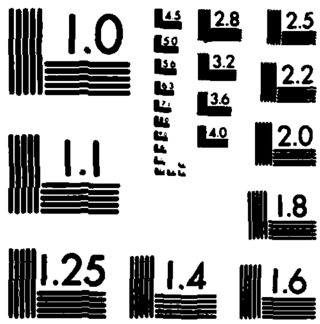
An audit of Administrative and Financial procedures of the "Red River Valley Flood Control" program was carried out by DSS Audit Services Bureau during months of June through September 1980. Observations included in their report contained as Appendix III are being or will be addressed toward the end of the program and during the post audit by DSS Services, Winnipeg. A letter from Mr. C. Collins (employee of the Board), dated October 22, 1980 indicated that the Manitoba Flood Disaster Assistance Board had received instructions to cease operations effective March 31, 1981. This should allow an orderly wrap-up of the financial program by mid summer of 1981.

This would mean once a firm cash flow prediction is available both the federal and provincial governments may need to get authority to carry some of the 1980 - 81 program allotment forward to fiscal year 81 - 82.

AD-A146 629 RED RIVER OF THE NORTH WALSH AND PEMBINA COUNTRIES 2/4
NORTH DAKOTA FARMSTEAD RING LEVEES(U) CORPS OF
ENGINEERS ST PAUL MN ST PAUL DISTRICT DEC 83

UNCLASSIFIED F/G 13/2 NL





'OPY RESOLUTION TEST CHART

APPENDIX I

DISASTER ASSISTANCE PROGRAMS

DISASTER ASSISTANCE PROGRAMS

1. Disaster Assistance Program

Emergency Planning Canada's role does not necessarily cease once an emergency is over. There is often a request for federal financial assistance to the provincial governments.

The Disaster Assistance Program, under the Government of Canada, Finance, was established to assist the provincial governments where the cost of dealing with a disaster would place undue burden on the provincial economy.

Prior to 1970, the cost sharing arrangements between the federal government and the provinces were negotiated with individual provinces on an ad hoc basis. Since 1970, the federal government's approach to disaster assistance, where the Government of Canada has formally agreed to share the reimbursement, has taken the form of reimbursing the provincial governments on the basis of a per capita formula. The formula established the amount of assistance that will be available given various levels of provincial expenditures on disaster relief that are considered eligible for cost sharing. The types of provincial expenditures considered eligible for cost sharing are defined in a set of administrative guidelines. Generally, these are expenditures made to restore to their pre-flood condition public works, the essential personal property of private citizens, farmsteads, and small businesses.

Under the cost-sharing formula, no sharing occurs unless provincial expenditures exceed an amount equal to $1 per capita. When a province's expenditures exceed this level, the amount of federal financial assistance payable to a province is determined as follows: 50 per cent of the next $2 per capita of provincial expenditures eligible for cost sharing; 75 per cent of the next $2 per capita and 90 per cent of the remainder.

.../2

Payments to provinces, including advance payments, if requested may be authorized by the Cabinet against the Treasury Board Contingencies Item. A special item is subsequently included in the estimates to reimburse the Contingencies Item. The nature of the program is such that it cannot be provided for in the Main Estimate.

While the Minister of Finance has over-all responsibility for disaster assistance, the details of cost sharing arrangements are administered by Emergency Planning Canada.

When cost sharing is arranged with a province, the EPC regional director is formally designated as the representative of the federal government. This involves damage assessment, detailed interpretation of the guidelines, a general surveillance of private damage claims and the development of joint federal-provincial teams to review the claims for agricultural and public sector damage.

The table below indicates how the program works.

Federal Post-Disaster Financial Assistance
(per capita sharing)

Provincial eligible expenditures	Federal share
First $1	nil
Next $2	50%
Next $2	75%
Remainder	90%

.../3

Example: population 800,000

Eligible expenses: $24,000,000

		Provincial	Federal	Federal Portion
1st $1 per capita	$ 800,000	$ 800,000	$	nil
Next $2 per capita	1,600,000	800,000	800,000	50%
Next $2 per capita	1,600,000	400,000	1,200,000	75%
Remainder	20,000,000	2,000,000	18,000,000	90%

2. Workmen's Compensation

Under workmen's compensation agreements the federal government assumes 75 per cent of the cost involving payments to civil defence workers injured during the course of C.D. duties. Claims for compensation must be documented by the Compensation Board of the province concerned.

APPENDIX II

PROTECTIVE MEASURES

5120/4-1)

Central Mortgage and Housing Corporation
Société centrale d'hypothèques et de logement

Winnipeg Office
Bureau de Winnipeg

MANITOBA FLOOD PROTECTION

July 31, 1979.

MOVING RAISING DYKING PROGRAM

This writer in company with Messrs. W. H. Willis, Regional Director, Emergency Planning, Canada, Sydney Reimer, Vice Chairman and Cyril Collins, Chief Inspection Officer both of the Manitoba Flood Disaster Assistance Board had the opportunity to view and carry out a federal initial inspection of many and various types of buildings situated on Red River Valley properties subjected to flooding during the Spring of 1979.

The prime purpose of this site inspection was to observe first hand the various methods being employed to provide long term protection from the possibility of future flood damage to all homes, farmsteads and other buildings outside present community dyking systems.

I list and comment where considered essential the most common and practical procedures employed although not necessarily in this order.

(1) Ring Dyking

(2) Padding - this terminology applied to raising areas with earth to above the 100 year flood level plus two feet and sufficient in size to accommodate one or more farm type buildings e.g. sheds, grain storage, barns and the like usually supported on surface type foundations.

(3) Relocation/Moving (A) short move within present property confines and/or simply raising and placing in both instances on a new foundation sited above the 100 year flood level plus two feet (B) relocation recommended within communal or other ring dyke systems where (A) not feasible.

(4) Raising on present basement type foundation not recommended unless the following carefully considered:

   (A) Height required to provide protection.
   (B) Structural soundness and possible remaining service life of present foundation.
   (C) Provide adequate lateral support to foundation walls bearing in mind the weakened joint between old and new wall sections and the additional swelling pressures of Red River Valley subsoils being applied to foundation due to raising of grade.

870 Portage Ave.
Winnipeg, Man
R3G 0P2

870, av. Portage
Winnipeg (Man.)
R3G 0P2

(CMHC)

MANITOBA FLOOD PROTECTION
MOVING RAISING DYKING PROGRAM

July 31, 1979

(5) Purchasing only where protection costs not feasible relative to appraisal values etc.

(6) Retaining Walls used to increase grading height - some fine examples of this type of protection were noted however it is generally limited to larger lots and homes not requiring more than 2 - 3 feet of gradient increase.

NOTE: All raised/moved buildings are then suitable terraced and graded.

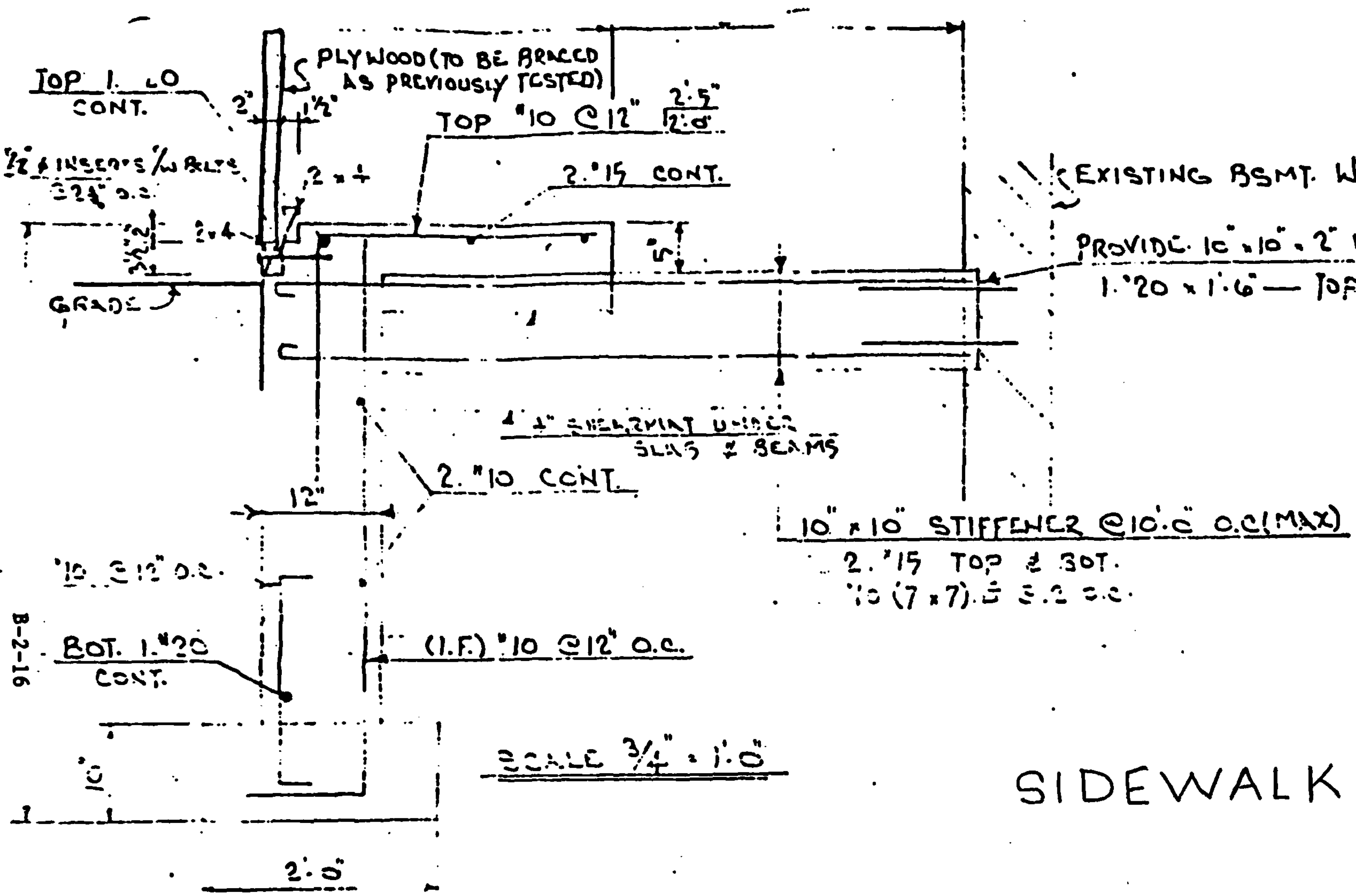
Summary

Of special interest was to note the number of mainly newer homes that survived this last flooding with little or no damage due to the owner's foresight to site their homes high enough and provided additional earth fill sloped to normal ground level. On larger properties this grading was able to be carried out so gradual that with landscaping and driveways completed the whole scene became an asset to the home surroundings. On smaller lots the same measure of protection was provided only then the gradient was more extreme.

A feature of the heavy clay soils of the Red River Valley is its ability to withstand water permeance and erosion particularly after grasses or other forms of vegetation have become established. This condition was noted on older existing dykes where no signs of detioration was evidenced, in fact some dyke systems were barely distinguishable from the natural landscaping. This same feature of heavy clay soils should permit where necessary slopes exceeding those normally recommended for earth grading.

The controls and engineering criteria are being applied in all sub-programs and building materials and construction standards, building codes and water engineering factors are employed.

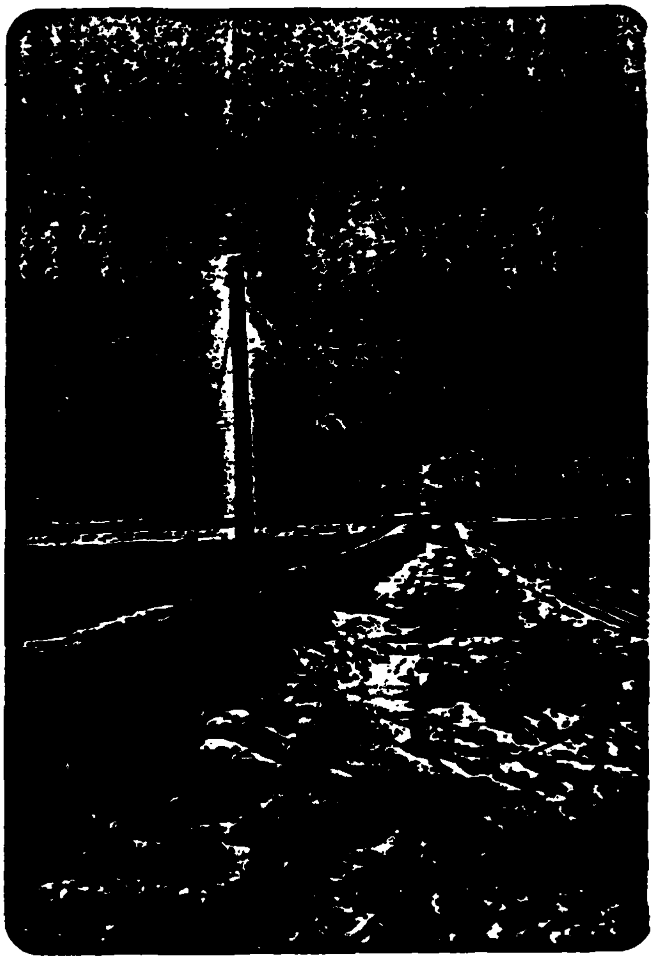
A. Fraser



SIDEWALK DYKE

PROPOSED – PERMANENT FOUNDATION FOR A
TEMPORARY DYKE DURING FLOOD PERIODS

GENERAL CONTRACTOR – HUDON & MACK



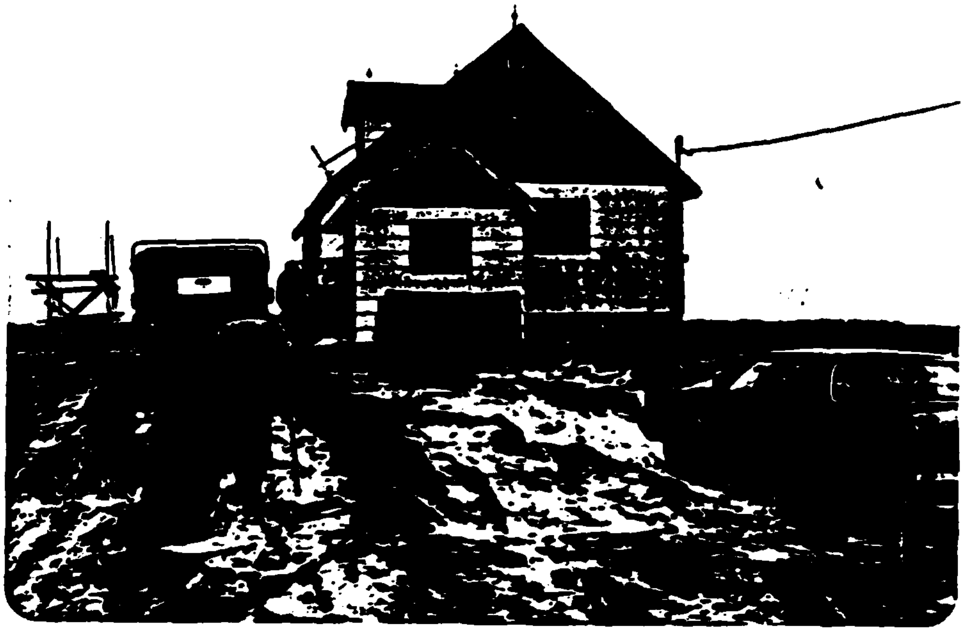
Note grass trapped on wire
during high water

Concrete Dyke

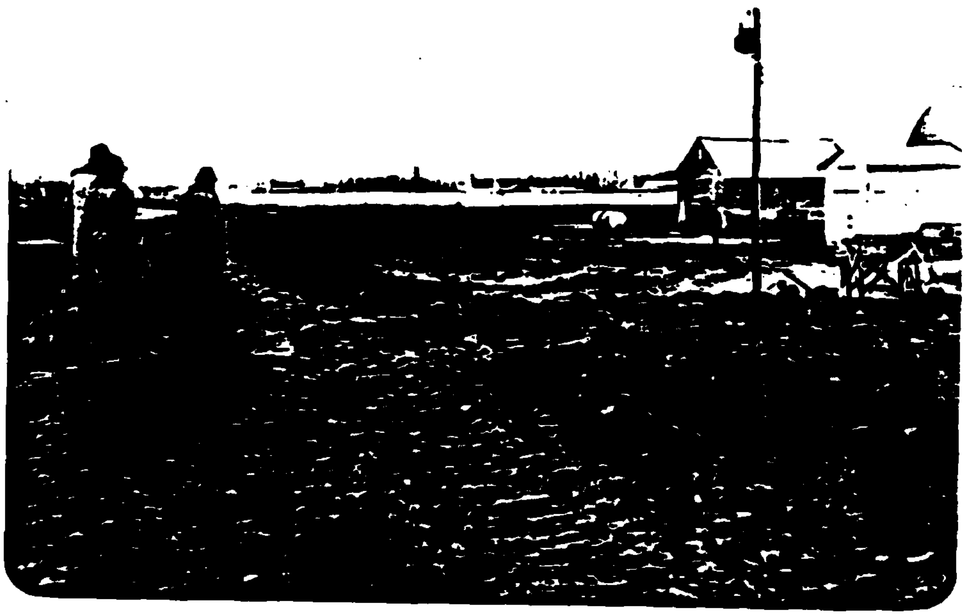
Portable Grain Silo

Sidewalk Dyke System for Demonstration
(Plastic on Plywood not shown)

Support System for Sidewalk Dyke



Home Moved, Repaired and Terraced



Dyking of Complete Barnyard

Buckling and Cracking Walls

Huge Padding Project

Barn Moving on Skids

House Moved and Raised

APPENDIX B

FARMSTEAD RING LEVEE WORK OF OTHERS

AND

STUDIES AND PROJECTS OF THE CORPS OF ENGINEERS

SECTION 3

HISTORY OF CORPS OF ENGINEERS

COMPLETED PROJECTS AND ONGOING STUDIES

PRIOR REPORTS AND HISTORY OF EXISTING PROJECTS

Prior reports for navigation and flood control on the Red River of the North and tributaries date from 1874 and 1936, respectively, and include a number of printed documents and information contained in annual reports of the Chief of Engineers. The early reports on navigation dealt with dredging, removal of obstructions, and construction of certain locks and dams on the Red River, Lake Traverse, Ottertail River, and Red Lake River. In general, these reports were favorable regarding dredging and removal of obstructions but were unfavorable regarding construction of locks and dams or reservoirs as aids to navigation. Since 1936, many reports have been completed concerning general and specific water resource problems and identifying certain plans and programs for solving the diversity of water problems in the Red River of the North basin. These latter efforts are summarized in the following paragraphs.

In 1936, planning was initiated by the Corps of Engineers for flood control and related purposes in the Red River basin. To respond to the drought in the 1930's, initial emphasis, however, was on water conservation. Projects that were constructed from studies undertaken during this period were planned primarily for water supply, with much less emphasis on flood control, recreation, and fish and wildlife. Examples of such projects include Lake Traverse (Bois de Sioux River, Minnesota) and Lake Ashtabula (Sheyenne River, North Dakota).

In the early 1940's, widespread flooding changed this emphasis, and Congress passed several resolutions in 1949 and 1950 (appendix A) that provided the Corps with the authority needed to take a more comprehensive look at the water problems of the basin. At that time, drainage of upland areas and inadequate channel capacities for the tributaries in the flat valley lands were considered the main causes of flood problems. Because the flat topography precluded the development of significant water storage areas, emphasis was placed on tributary channel improvements and levees to reduce damages at the principal urban damage

centers. Seven more projects were constructed during this period in the Ottertail, Wild Rice-Marsh, Park, Red Lake, Rush, and Sheyenne River subbasins. Also, several studies in other subbasins were ongoing at this time.

Despite these improvements, widespread near-record floods occurred again during the 1950's. This additional emphasis on flood control resulted in a current basin study being initiated in 1956. Immediately, several critical areas were identified for special attention. Studies in these areas resulted in the authorization of three channel improvement projects, three reservoirs, and four local protection projects. Four of these projects (two channel improvement projects and two local protection levees) have been constructed; the rest remain in the advance planning stage. Several recent studies have dealt with flood problems in the Red River basin; however, only a few studies and their corresponding reports have been concerned with farmstead ring levees. These include the Souris-Red-Rainy River Basins Comprehensive Study, 1972; the Main Stem Subbasin Final Report, December 1980; the Section 205 Red River of the North Farmstead Flood Control Reconnaissance Report, Walsh County, North Dakota, 20 February 1981; and the Red River of the North Main Stem Technical Information Report, July 1982. Finally, the Preliminary Basin-wide Review Study completed in 1980 specifically identified farmstead ring levees as an important ingredient in future flood control actions in the basin.

Table 1 provides a breakdown of the Corps of Engineers projects constructed in the basin since 1936, including pertinent data on the projects and flood damages prevented by each. General location maps are attached.

Table 1 - Summary of completed Corps of Engineers Red River projects

State	Project location	Type of project	Date construction completed	Pertinent data	Approximate project cost	Flood damages prevented (cumulative through 1982)
MN-SD	Bois de Sioux River	Reservoir and channel improvement	1948	Provides for use of Lake Traverse as a flood control and water conservation reservoir and 23.8 miles of channel improvement in the Bois de Sioux River. Flood control storage is 137,000 acre-feet.	$1,340,000	$6,471,000
MN	Ottertail River	Reservoir	1953	Provides for multiple-purpose impoundment created by Orwell Dam located near Fergus Falls to be used to control floods and increase low flows for water supply and pollution abatement. Recreation facilities are also included. 13,100 acre-feet of dual-use storage is provided for flood control and low-flow supplements.	$1,900,000	$3,461,000
MN	Ottertail River	Channel improvement	1954	Provides for 11.4 miles of cleaning, enlarging, and straightening the Ottertail River for flood control.	$175,000	$991,000
MN	Wild Rice-Marsh Rivers	Channel improvement	1954	Provides for 38.9 miles of enlarging, straightening, and cleaning of the Wild Rice and Marsh Rivers for flood control.	$400,000	$4,509,000
ND	Park River	Reservoir	1956	Provides for a multiple-purpose impoundment created by Homme Dam to be used for partial flood control protection and meeting the needs for water conservation. Recreation facilities are included. 3,550 acre-feet of dual-use storage is available for low-flow supplement with 1,100 acre-feet of this used for flood control each spring.	$1,450,000	$782,000

Table 1 - Summary of completed Corps of Engineers Red River projects (cont)

State	Project location	Type of project	Date construction completed	Pertinent data	Approximate project cost	Flood damages prevented (cumulative through 1982)
MN	Red Lake River including Clearwater River	Channel improvement and reservoir	1956	Provides for rectification and enlargement of portions of the Red Lake and Clearwater River channels; modification of the outlet structure of Lower Red Lake; construction of a structure to preserve marshes; and road and bridge alteration for flood control, water supply, and pollution abatement. Total usable flood control and water supply storage is 1,547,000 acre-feet of which 847,000 is used for low-flow supplement.	$3,150,000	$6,344,000
ND	Rush River	Channel improvement	1956	Provides for 26.9 miles of cleaning, enlarging, and straightening the Rush River for flood control.	$290,000	$1,386,000
ND	Sheyenne River	Reservoir	1956	Provides for a multiple-purpose impoundment created by Baldhill Dam to be used to control floods and regulate low flows for water supply and pollution abatement. Recreation facilities are provided. 69,500 acre-feet of dual-use storage for flood control and water supply with 18,000 acre-feet normally used for flood control each spring.	$3,350,000	$45,527,000
ND	Maple River	Channel improvement and levee	1957	Provides for snagging and clearing of 1 mile of the Maple River through Enderlin for flood control.	$20,000	$182,000
MN	Mustinka River	Channel improvement	1957	Provides for 36.1 miles of cleaning, straightening, and enlarging the Mustinka River and its tributaries for flood control.	$440,000	$1,670,000

Table 1 - Summary of completed Corps of Engineers Red River projects (cont)

State	Project location	Type of project	Date construction completed	Pertinent data	Approximate project cost	Flood damages prevented (cumulative through 1982)
MN	Sand Hill River	Channel improvement	1958	Provides for 20.1 miles of enlarging, straightening, and cleaning of the Sandhill River for flood control.	$550,000	$2,662,000
ND	Grand Forks	Levee	1959	Provides for 5,930 feet of levee and floodwall at Grand Forks for flood control.	$950,000	$10,399,000
ND	Fargo	Channel improvement and levee	1961	Provides for four channel cutoffs and for a 3,500-foot levee, all for protection to the city of Fargo from Red River floods.	$1,600,000	$6,860,000
MN	Lost River	Channel improvement	1966	Provides for 43.3 miles of cleaning and snagging and channel deepening, widening, and straightening for flood control.	$760,000	$1,490,000
ND	Lower Branch Rush River	Channel improvement	1975	Provides for 24.8 miles of enlarging and straightening of the Lower Branch Rush River and a southern tributary, two channel cutoffs, bridge and culvert modifications, and other assorted works for flood control.	$1,000,000	$733,000
MN	Oslo	Levee	1976	Provides for 18,690 feet of levee and associated works surrounding Oslo for flood control.	$1,500,000	$8,193,000
ND	Pembina	Levee	1977	Provides for 15,600 feet of levee and floodwall and associated works around Pembina for flood control.	$2,000,000	$10,683,000
MN	Wild Rice River	Channel Improvement	1983	Provides for increasing the capacities of the South Branch and Felton Ditch channels by widening the existing channel, removing debris, and by diking along the channel. New bridges and other assorted flood control works are included in this project. Total length of channel improvement is 37 miles.		(N/A)
Total					$20,875,000	$112,343,000

These 18 completed projects cost about $21 million to construct and have prevented over $112 million in flood damages since 1965. In fact, only three projects have not paid for themselves as yet in flood control benefits. One (Homme Dam and Lake) is primarily a water supply project which has provided numerous benefits during recent drought conditions. The others (Lower Branch Rush River and Wild Rice River-South Branch and Felton Ditch) were constructed in 1975 and 1983, respectively.

ONGOING STUDIES

The Corps of Engineers also has several studies under way; some are authorized and others are being done under special authorities. Table 2 provides a summary of each of these ongoing activities. Included are the six authorized projects.

Table 2 - Summary of St. Paul District, Corps of Engineers studies ongoing in the Red River basin

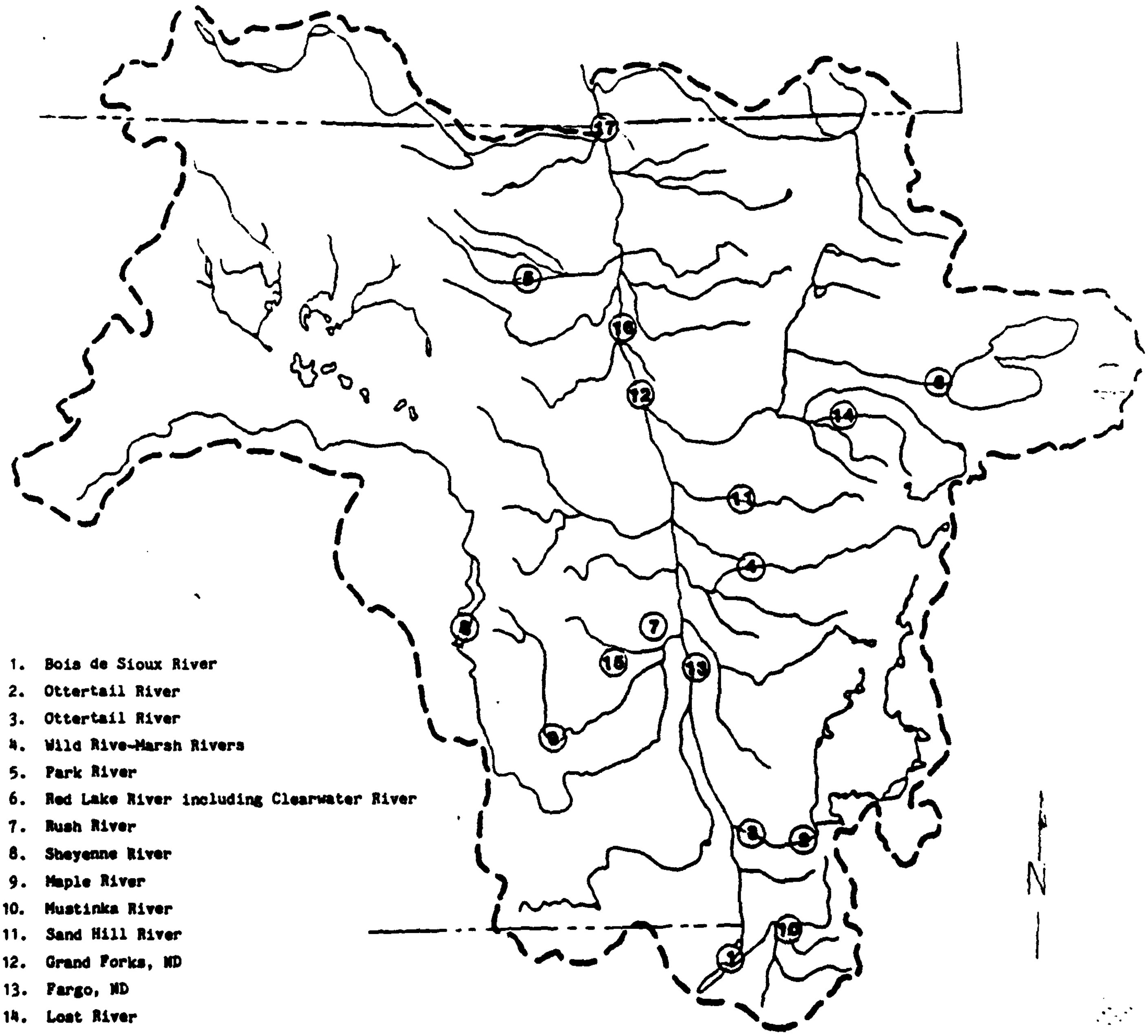
Study (1)	Authorization	Project description	Estimated study completion date	Estimated completion date of construction
Alvarado, MN	Section 205, 1948 Flood Control Act	Levee and associated works	Sep 1984	Sep 1986
Argusville, ND	Section 205, 1948 Flood Control Act	Levee and associated works	Mar 1984	Sep 1986
Argyle, MN	Section 105, 1948 Flood Control Act	Levee and associated works	Feb 1984	Sep 1985
Devils Lake, ND	Section 205, 1948 Flood Control Act	Levee and associated works	Jul 1983	Sep 1984
East Grand Forks, MN	Flood Control Acts of 1948, 1950, and 1970	Levee and associated works	Oct 1984	Mar 1990
Enderlin, ND	Section 205, 1948 Flood Control Act	Levee and associated works	Jul 1982	Sep 1985
English Coulee, ND	Section 205, 1948 Flood Control Act	Closure structure and pumping station	Feb 1986	Sep 1987
Fargo-Moorhead Urban Water Resources	Red River of the North General	(2)	Sep 1984	(3)
Halstad, MN	Section 205, 1948 Flood Control Act	Ring levee and associated works	Nov 1982	Nov 1984
Park River, ND	1976 Water Resource Development Act	Levee and bypass channel	Jan 1983	(3)
Pembina River, ND	1976 Water Resource Development Act	Multiple-purpose reservoir	Sep 1983	(3)
Red River basin (4)	Red River of the North General	(2)	Sep 1988	(2)
Roseau, MN	Flood Control Act of 1965	Channel improvements and associated works	Completed	Sep 1987
Sheyenne River, ND	Flood Control Act of 1970	Levees, diversion channels, reservoir, multiple-purpose reservoir, and nonstructural measures	Jan 1990	Sep 1993
Snake River, MN	Section 205, 1948 Flood Control Act	Snagging and clearing	Jan 1982	(5)
Wild Rice River, MN	Flood Control Act of 1970	Multiple-purpose reservoir	Apr 1987	Sep 1991

(1) Does not include activities under Section 22, emergency operations, floodplain management services, and permits.
(2) Dependent on results of study.
(3) Dependent on congressional authorization and completion of any remaining studies.
(4) Includes the Red River main stem, farmstead ring levees, strategy report, Devils Lake computer models and basin-wide planning.
(5) Dependent upon receipt of Local Cooperation Agreement.

In addition to these ongoing studies, the Corps is engaged in a number of other activities throughout the basin. Emergency operations assistance is available to local governments whenever flood and drought emergencies occur. Various technical studies, relating to floodplain information and wetland preservation, are being conducted for the States of Minnesota and North Dakota under the Corps' Section 22 authority. As part of the overall Red River basin study, the Corps has developed hydraulic and economic computer models along the main stem and basin-wide hydrologic models for high and low flows. Corps of Engineers permitting authority applies to actions that affect all navigable waters and wetlands in the basin. The Corps is engaged in extensive coordination and advisory efforts with other agencies and international groups such as the International Joint Commission and the Souris-Red Rivers Engineering Board. Finally, operation and maintenance of completed projects is an ongoing responsibility of the Corps, except for small local protection projects which are maintained by the local sponsors.

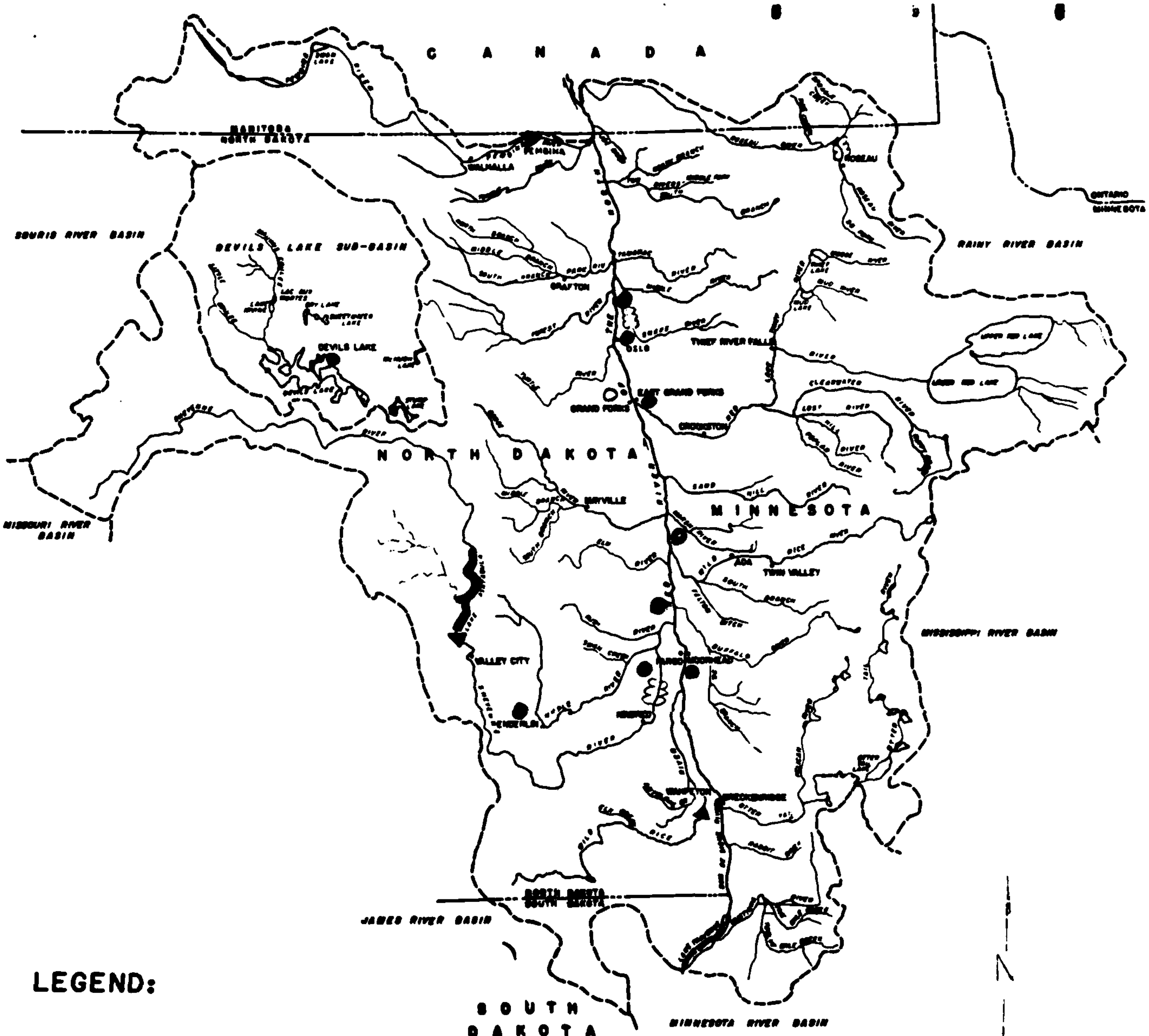
COMPLETED FLOOD CONTROL PROJECTS

CORPS OF ENGINEERS



1. Bois de Sioux River
2. Ottertail River
3. Ottertail River
4. Wild Rive-Marsh Rivers
5. Park River
6. Red Lake River including Clearwater River
7. Rush River
8. Sheyenne River
9. Maple River
10. Mustinka River
11. Sand Hill River
12. Grand Forks, ND
13. Fargo, ND
14. Lost River
15. Lower Branch Rush River
16. Oslo, MN
17. Pembina, ND

ONGOING RED RIVER OF THE NORTH BASIN STUDIES



LEGEND:

- RESERVOIR
- LEVEE
- CHANNEL IMPROVEMENT
- LOCAL PROTECTION

APPENDIX C

TECHNICAL INFORMATION

SECTION 1
HYDROLOGY AND HYDRAULICS
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APPENDIX C

TECHNICAL INFORMATION

SECTION 1

HYDROLOGY AND HYDRAULICS

HYDROLOGY AND HYDRAULICS

The Red River basin hydrology is well-defined and documented in past and recent reports. Significant information exists on general study area characteristics, topography, climate, floods and runoff characteristics. This information is briefly identified in the main report. This section presents more detailed information on frequency curves, rating curves and water surface profiles.

FREQUENCY

Annual instantaneous peak discharge-frequency curves have been developed for a number of locations on the Red River of the North. A summary of the flow frequency data is shown in tables C-1-1 to C-1-4. These curves are used for design rather than floodplain management. This section presents the discharge frequency curves at Grand Forks, Oslo, Drayton and Emerson. The curves are shown on plates C-1-1 to C-1-4.

The curves at Emerson and Grand Forks were derived analytically in accordance with guidelines set forth in the Unites States Water Resources Council Bulletin 17A and HEC computer program 723-X6-L7550, "Flood Flow Frequency Analysis." A comparison was made with curves derived in accordance with Bulletin 17B. There was not a noticeable difference between the two curves. The discharge frequency curve at Grand Forks was based on 154 years of historic record (1826, 1852, 1882-1979) and expected probability. The discharge frequency curve at Emerson was also based on 154 years of historic record (1826, 1852, 1913-1979) and expected probability. The rank and plotting positions shown on plates C-1-1 and C-1-4 and tables C-1-5 and C-1-7 were computed using Weibull plotting formula. These plates also show the 0.95 and 0.05 confidence limit curves.

Plate C-1-3 shows the discharge frequency curve for Drayton, North Dakota. This curve was derived for annual instantaneous peaks by correlating the 41 years of record at Drayton (1936, 1937, 1941-1979) with the longer 154 years of historic record at Grand Forks. HEC computer program 723-X6-27350 "Regional Frequency Computation" dated July 1972 was used to make the correlation. A two-station comparison was used as per Bulletin 17B, Appendix 7, to compare with the regional program results. There was no noticeable difference between the two curves. The regional program ranked the observed values with the estimated values. Weibull plotting positions were then assigned to the observed flow values and are shown on plate C-1-3 and table C-1-6.

Plate C-1-2 shows the annual instantaneous peak discharge frequency curve for Oslo, North Dakota. There is no gaging information at Oslo; therefore, this curve was derived using general relations with the curve at Grand Forks, North Dakota, and the curve at Drayton, North Dakota.

In the flood frequency analyses, consideration was given to the possible effects of manmade improvements (i.e., drainage works, land use changes, changes in agricultural practices, and storage developments). The existing period of record was used in the determination of graphical and analytical portions of the discharge-frequency curves. The curves were then compared with past discharge-frequency curves. No significant changes have occurred in the upper portions of the curves; however, the lower portions of the curves do show change. It appears that the development of the above-mentioned manmade features could have influenced the existing hydrology of recent floods. However, equal consideration must be given to the natural factors such as climatic variation which might be far more significant in influencing existing hydrology than any manmade improvements.

In 1971, the U.S. Geological Survey completed a report defining the regional flood for the Red River. This report was prepared in cooperation with the States of Minnesota and North Dakota, Corps of

Engineers and Soil Conservation Service. In 1972, the regional flood profile and discharges were adopted for use by the various State and Federal agencies. The regional flood is that flood which has a 1-percent chance of being equaled or exceeded in any given year; over a long period of time, it will have an average recurrence interval of 100 years. This flood, commonly referred to as the 1-percent chance or 100-year flood, is used by both States for floodplain management on the main stem. The States' criteria on agricultural levees also relate maximum allowable stage increases to this particular flood profile. The 1-percent exceedence frequency flood for floodplain management purposes is derived using P and, therefore, is not adjusted for expected probability. The 1-percent chance flood for the Red River at Grand Forks is 89,000 cfs.

Corps of Engineers regulations specify that the most current frequency curves with expected probability adjustment (Pn) be used for planning and design of Corps projects. Several major floods have occurred since 1972. Discharge data for these floods and for three floods in the last half of the 19th century have led to revisions in the Corps frequency curves. The 1-percent exceedence frequency flood on the Red River at Grand Forks for planning and design work is 106,000 cfs.

Table C-1-1

Flood frequency, discharge, and elevation data for Red River gaging stations

Flood frequency in percent chance of occurrence(1)	Grand Forks Peak flow (cfs)	Grand Forks Elevation (feet)	Grand Forks Frequency comparison of historic flood(2)	Oslo Peak flow (cfs)	Oslo Elevation (feet)	Oslo Frequency comparison of historic flood(2)	Drayton Peak flow (cfs)	Drayton Elevation (feet)	Drayton Frequency comparison of historic flood(2)	Emerson Peak flow (cfs)	Emerson Elevation (feet)	Emerson Frequency comparison of historic flood(2)
50	14,400	804.5		15,200	800.0		17,500	783.5	10 Apr 1980 (22,400 cfs)	19,700	768.7	9 Apr 1980 (22,00 cfs)
Channel capacity	27,000	814.8		20,000	802.8		25,000	788.8	(8 Apr 1967 (32,200 cfs)	35,000	781.6	
20	29,000	816.1	23 Apr 1916 (29,000 cfs)	30,500	806.5	4 Apr 1967 (32,000 cfs) 15 Jul 1975 (42,400 cfs)	34,500	792.5	22 Apr 1965 (47,200 cfs)	37,000	782.7	29 Apr 1970 (39,600 cfs)
10	41,000	820.8	14 Jul 1975 (42,800 cfs)	43,000	808.6		48,000	795.2	19 Apr 1969 (59,000 cfs)	51,500	787.3	27 Apr 1948 (51,800 cfs) 11 Apr 1966 (66,800 cfs)
5	54,000	824.1	4 Apr 1966 (55,000 cfs)	56,000	809.4	17 Apr 1969 (56,500 cfs) 10 May 1950 (63,000 cfs)	62,000	796.7		67,000	789.3	
2	74,000	827.3	23 Apr 1979 (82,000 cfs)	75,500	809.9		82,500	797.9	28 Apr 1979 (92,900 cfs)	90,000	790.6	
1	89,000	828.7		91,000	810.4		99,000	798.4		109,000	791.6	13 May 1950 (95,500 cfs)

(1) Flood frequency in percent chance of occurrence has been used throughout this report to be consistent with Corps of Engineers uniform terminology. For example, the 1-percent flood has one chance in 100 of being equaled or exceeded in any given year. This flood is commonly called the 5-year flood.

(2) The date of the historic flood may vary from one gaging station to aonther due to variations in local flow, precipitation, snowmelt, overbank flooding, etc. Peak flow (cfs) is shown in parenthesis underneath the date.

RED RIVER OF THE NORTH MAIN STEM
FARMSTEAD RING LEVEES
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TABLE C-1-2 - FREQUENCY DATA - DESIGN VALUES

LOCATION	MEAN LOG / STANDARD DEVIATION	SKEW / EQUIVAL LENGTH	DISCHARGE IN CFS — EXCEEDENCE FREQUENCY IN PERCENT (RETURN PERIOD IN YEARS) 10 (10)	4 (25)	2 (50)	1 (100)	.2(500)
WAHPETON,	3.252	-.19	5350	7700	9800	12000	19000
NORTH DAKOTA	0.374	88					
FARGO,	3.475	0.0	11100	18100	24900	33300	60800
NORTH DAKOTA	0.438	98					
HALSTAD,	3.873	-.19	23600	34900	45000	56000	87000
MINNESOTA	0.393	96					
GRAND FORKS,	4.1558	-.20	45000	66400	84900	106000	161000
NORTH DAKOTA	0.3911	154					
OSLO,	(1)		46000	67500	85000	106500	161500
MINNESOTA							
DRAYTON,	4.220	-.203	48000	69000	87000	107000	162000
NORTH DAKOTA	0.360	96					
EMERSON	4.2973	0.0	53800	77000	99000	122000	193000
MANITOBA	0.3302	154					

(1) DISCONTINUED, DISCHARGES DEVELOPED FROM FREQUENCY CURVES AT GRAND FORKS AND DRAYTON.

RED RIVER OF THE NORTH MAIN STEM
FARMSTEAD RING LEVEES
HYDROLOGY
TECHNICAL APPENDIX
DECEMBER 1983

TABLE C-1-3 - FREQUENCY DATA - DESIGN GENERAL RELATIONS

LOCATION	TOTAL DRAINAGE AREA IN SQUARE MILES(2)	DISCHARGE IN CFS (1) EXCEEDENCE FREQUENCY IN PERCENT (RETURN PERIOD IN YEARS)				
		10 (10)	4 (25)	2 (50)	1 (100)	.2(500)
WAHPETON (3)	4010	5350	7700	9800	12000	19000
HICKSON (5)	4300	5890	8620	11100	13700	22200
ABOVE MOUTH WILD RICE, ND	4430	6140	9050	11700	14500	23700
BELOW MOUTH	6660	10800	17500	24000	32000	58100
FARGO, ND (3)	6800	11100	18100	24900	33300	60800
ABOVE MOUTH SHEYENNE (4)	7230	11500	18800	25800	34600	63100
BELOW MOUTH	17930	15700	25400	34700	46100	82700
ABOVE MOUTH BUFFALO	18140	16100	25900	35200	46600	83000
BELOW MOUTH	19330	18400	28700	38300	49700	84300
ABOVE MOUTH ELM RIVER, ND	19570	18800	29300	39000	50300	84600
BELOW MOUTH	20080	19900	30500	40300	51600	85200
ABOVE MOUTH WILD RICE, MN	20110	19900	30600	40400	51700	85200
BELOW MOUTH	21760	23500	34800	44900	55900	87000
HALSTAD (3)	21800	23600	34900	45000	56000	87000
ABOVE MOUTH GOOSE	22090	24600	36600	47300	59000	92200
BELOW MOUTH	23360	29500	44800	58200	73600	118000
ABOVE MOUTH SANDHILL	23720	31000	47300	61700	78200	126000
BELOW MOUTH	24150	32800	50500	65900	83900	136000
ABOVE MOUTH RED LAKE (4)	24350	33700	52000	68000	86700	141000
BELOW MOUTH	30100	45000	66400	84900	106000	161000
GRAND FORKS (3)	30100	45000	66400	84900	106000	161000
OSLO (3)	31200	46000	67500	85000	106500	161500

TABLE C-1-4
FREQUENCY DATA - DESIGN GENERAL RELATIONS

LOCATION	TOTAL DRAINAGE AREA IN SQUARE MILES(2)	DISCHARGE IN CFS (1) EXCEEDENCE FREQUENCY IN PERCENT (RETURN PERIOD IN YEARS) 10 (10)	4 (25)	2 (50)	1 (100)	.2(500)
ABOVE MOUTH FOREST	31250	46000	67500	85000	106500	16150
BELOW MOUTH	32270	46600	68000	85600	106700	16170
ABOVE MOUTH SNAKE	32300	46600	68000	85600	106700	16170
BELOW MOUTH	33250	47200	68400	86200	106800	16160
ABOVE MOUTH PARK	33280	47200	68400	86200	106800	16160
BELOW MOUTH	34290	47700	68800	86700	106900	16190
ABOVE MOUTH TAMARAC	34310	47700	68800	86700	106900	16190
BELOW MOUTH	34640	47900	68900	86900	107000	16200
DRAYTON (3)	34800	48000	69000	87000	107000	16200
ABOVE MOUTH TWO RIVERS	34970	48200	69300	87400	107500	16300
BELOW MOUTH	36200	49500	71100	90100	110900	17000
ABOVE MOUTH PEMBINA	36230	49600	71200	90200	111000	17010
BELOW MOUTH	40180	53800	77000	99000	122000	19300
EMERSON,MAN. (3)	40200	53800	77000	99000	122000	19300

(1)THESE FLOW VALUES ARE BASED ON RECORDS THROUGH 1979 AND ARE CONSISTENT WITH THE DESIGN VALUES IN TABLE 2. THESE VALUES WERE DETERMINED BY USING GENERAL RELATIONS EXCEPT WHERE NOTED.

(2)THE TOTAL DRAINAGE AREA INCLUDES THE CLOSED BASIN OF DEVILS LAKE AND OTHER NON-CONTRIBUTING AREAS. DRAINAGE AREAS ABOVE AND BELOW THE MOUTHS OF RIVERS WERE ESTIMATED FROM AVAILABLE DATA.

(3)THESE ARE THE VALUES FROM TABLE 2.

(4)THESE VALUES WERE COMPUTED FROM PERIOD OF RECORD ROUTINGS.

(5)STATION BEGIN IN 1975, VALUES DETERMINED BY GENERAL RELATIONS.

TABLE C-1-5
PLOTTING POSITIONS FOR ADOPTED FREQUENCY CURVE
OF ANNUAL INSTANTANEOUS PEAK FLOWS AT
GRAND FORKS, NORTH DAKOTA

Rank	Water Year	Flow in cfs	Weibull Plotting in Percent	Rank	Water Year	Flow in cfs	Weibull Plotting Position
1	1826	135,000	.0065	51	1949	15,200	.5014
2	1852	95,000	.0129	52	1902	15,000	.5115
3	1897	85,000	.0211	53	1957	14,700	.5215
4	1979	82,000	.0311	54	1953	14,600	.5315
5	1882	75,000	.0411	55	1936	14,500	.5415
6	1966	55,000	.0512	56	1901	14,000	.5515
7	1978	54,200	.0612	57	1919	13,600	.5615
8	1950	54,000	.0712	58	1941	13,400	.5715
9	1969	53,500	.0812	59	1964	13,200	.5815
10	1893	53,300	.0912	60	1885	13,040	.5915
11	1965	52,000	.1012	61	1928	12,200	.6015
12	1975	42,900	.1112	62	1921	11,500	.6115
13	1883	38,600	.1212	63	1973	11,200	.6215
14	1947	35,000	.1312	64	1942	11,000	.6315
15	1948	34,200	.1412	65	1963	10,800	.6415
16	1974	34,100	.1512	66	1886	10,800	.6515
17	1904	33,000	.1612	67	1927	10,600	.6616
18	1972	31,400	.1712	68	1944	10,400	.6716
19	1907	30,400	.1812	69	1932	10,400	.6816
20	1920	30,300	.1912	70	1940	10,000	.6916
21	1916	29,000	.2013	71	1925	9,690	.7016
22	1967	28,200	.2113	72	1954	9,620	.7116
23	1943	28,200	.2213	73	1930	9,610	.7216
24	1906	27,600	.2313	74	1968	9,420	.7316
25	1962	26,600	.2413	75	1909	9,260	.7416
26	1952	23,900	.2513	76	1899	9,000	.7516
27	1970	23,700	.2613	77	1914	8,240	.7616
28	1951	23,600	.2713	78	1926	7,720	.7716
29	1976	23,600	.2813	79	1958	7,500	.7816
30	1892	23,000	.2913	80	1887	7,300	.7916
31	1946	22,000	.3013	81	1939	6,720	.8016
32	1917	21,600	.3113	82	1938	6,660	.8117
33	1896	21,600	.3213	83	1959	6,300	.8217
34	1915	21,500	.3313	84	1891	6,000	.8317
35	1956	21,400	.3413	85	1912	4,730	.8417
36	1945	21,300	.3513	86	1898	4,500	.8517
37	1884	20,600	.3614	87	1918	4,480	.8617
38	1908	20,500	.3714	88	1933	4,380	.8717
39	1888	19,000	.3814	89	1937	4,180	.8817
40	1922	19,000	.3914	90	1900	4,000	.8917
41	1903	18,800	.4014	91	1911	3,520	.9017
42	1910	18,500	.4114	92	1890	3,470	.9117
43	1913	17,200	.4214	93	1961	3,400	.9217
44	1960	17,200	.4314	94	1934	3,210	.9317
45	1929	17,100	.4414	95	1889	3,000	.9417
46	1905	16,800	.4514	96	1935	2,920	.9517
47	1894	16,450	.4614	97	1924	2,530	.9618
48	1923	16,200	.4714	98	1977	2,190	.9718
49	1971	15,800	.4814	99	1895	2,000	.9818
50	1955	15,400	.4914	100	1931	1,630	.9918

NOTE - Plotting Positions based on 154 years (H) and 2 high values (Z).
Weight (W) for systematic values = 1.5510.

TABLE C-1-6
PLOTTING POSITION FOR ADOPTED FREQUENCY CURVE
OF ANNUAL INSTANTANEOUS PEAK FLOWS AT
DRAYTON, NORTH DAKOTA

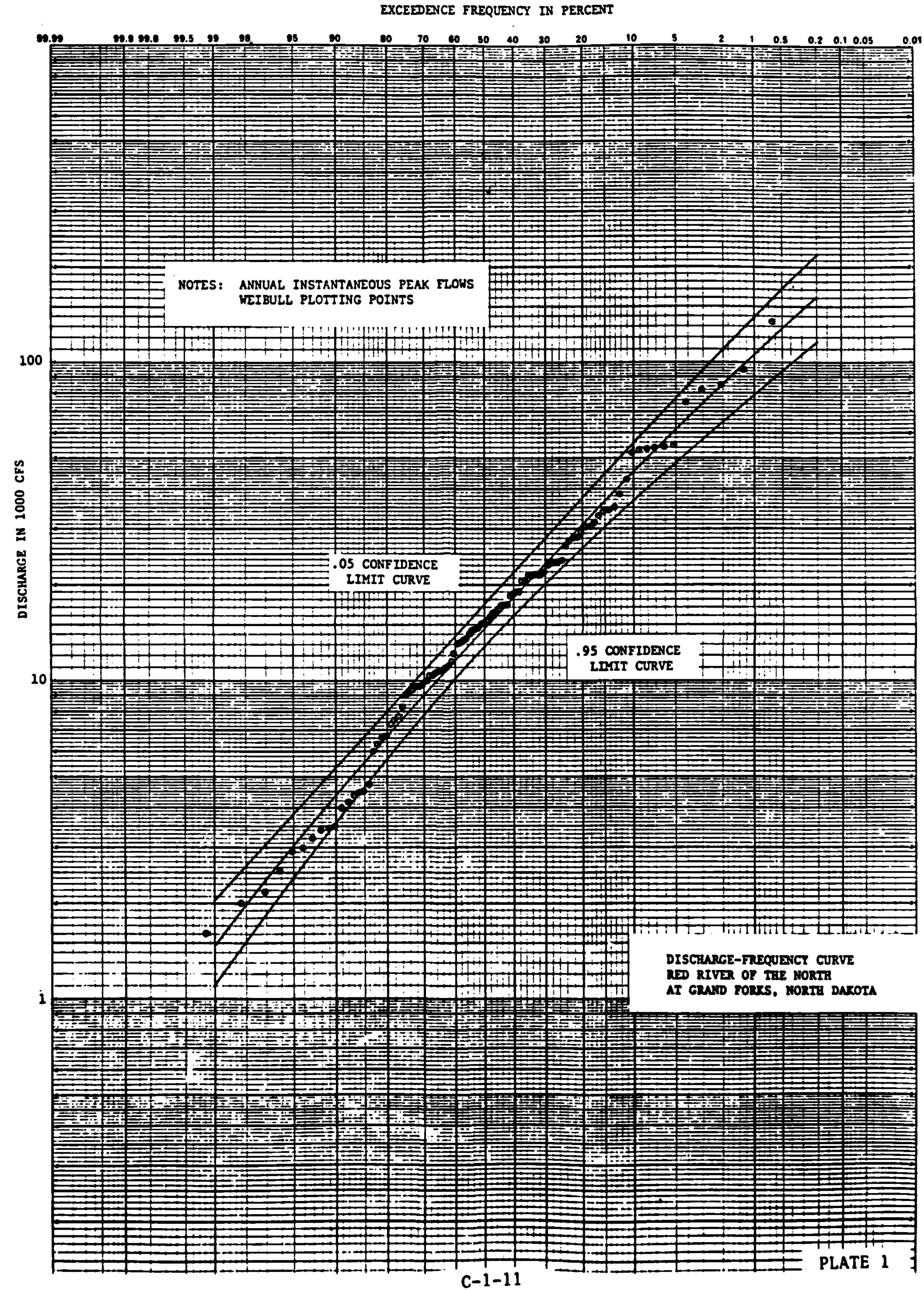
Rank	Water Year	Flow in cfs	Weibull Plotting Position	Rank	Water Year	Flow in cfs	Weibull Plotting Position
1			.0101	50	1955	18,000	.5051
2	1979	92,900	.0202	51		(1)	.5152
3	1950	86,500	.0303	52		(1)	.5253
4		(1)	.0404	53	1936	16,600	.5354
5	1966	67,500	.0505	54		(1)	.5455
6	1969	59,000	.0606	55		(1)	.5556
7	1948	57,000	.0707	56		(1)	.5657
8	1978	56,200	.0808	57		(1)	.5758
9		(1)	.0909	58	1964	15,600	.5859
10	1965	47,200	.1010	59		(1)	.5960
11	1975	44,000	.1111	60	1953	14,700	.6061
12	1974	43,900	.1212	61		(1)	.6162
13		(1)	.1313	62	1957	14,100	.6263
14	1967	32,300	.1414	63	1973	13,400	.6364
15	1962	32,200	.1515	64		(1)	.6465
16		(1)	.1616	65	1963	12,900	.6566
17	1970	31,700	.1717	66		(1)	.6667
18	1972	31,100	.1818	67	1968	12,500	.6768
19		(1)	.1919	68		(1)	.6869
20		(1)	.2020	69	1944	12,300	.6970
21		(1)	.2121	70		(1)	.7071
22	1947	29,300	.2222	71	1959	11,200	.7172
23		(1)	.2323	72	1954	11,100	.7273
24		(1)	.2424	73		(1)	.7374
25	1943	28,700	.2525	74		(1)	.7475
26	1956	28,000	.2626	75		(1)	.7576
27	1949	27,900	.2727	76		(1)	.7677
28	1976	27,600	.2828	77		(1)	.7778
29		(1)	.2929	78		(1)	.7879
30		(1)	.3030	79	1958	7,850	.7980
31		(1)	.3131	80		(1)	.8081
32		(1)	.3232	81		(1)	.8182
33	1960	24,700	.3333	82		(1)	.8283
34	1945	24,600	.3434	83		(1)	.8384
35	1951	24,600	.3535	84		(1)	.8485
36	1952	23,900	.3636	85		(1)	.8586
37	1971	23,300	.3737	86		(1)	.8687
38		(1)	.3838	87		(1)	.8788
39	1946	23,000	.3939	88		(1)	.8889
40	1941	22,800	.4040	89	1937	4,530	.8990
41		(1)	.4141	90		(1)	.9091
42	1942	21,900	.4242	91		(1)	.9192
43		(1)	.4343	92		(1)	.9293
44		(1)	.4444	93		(1)	.9394
45		(1)	.4545	94		(1)	.9495
46		(1)	.4646	95	1961	3,600	.9596
47		(1)	.4747	96		(1)	.9697
48		(1)	.4848	97	1977	3,400	.9798
49		(1)	.4949	98		(1)	.9899

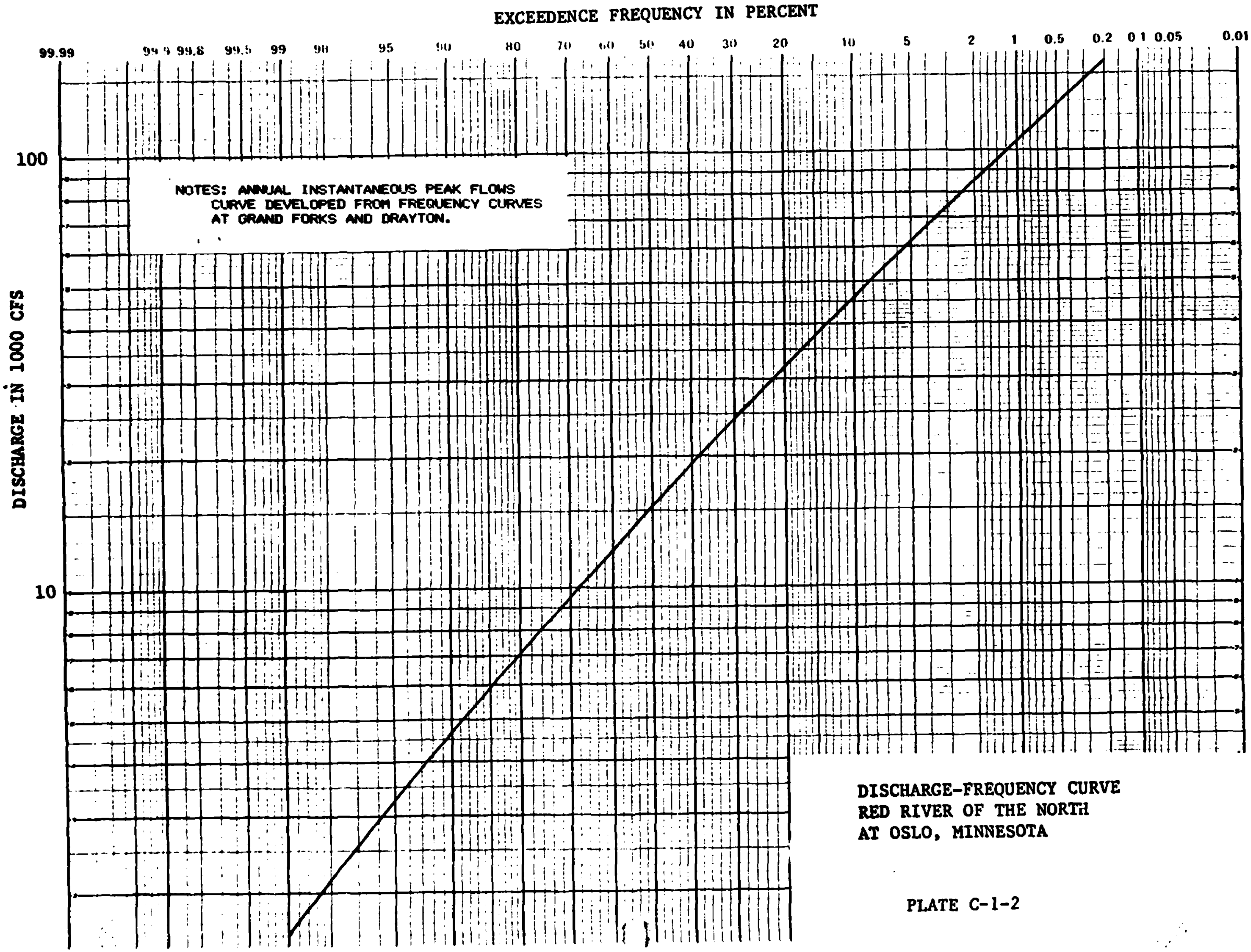
(1) Spacing of data based on Regional Frequency Program.

TABLE C-1-7
PLOTTING POSITIONS FOR ADOPTED FREQUENCY CURVE
OF ANNUAL INSTANTANEOUS PEAK FLOWS AT
EMERSON, MANITOBA

Rank	Water Year	Flow in cfs	Weibull Plotting Position	Rank	Water Year	Flow in cfs	Weibull Plotting Position
1	1826	167,000	.0065	36	1927	20,500	.5065
2	1852	120,000	.0129	37	1915	20,121	.5211
3	1950	95,500	.0234	38	1929	19,200	.5357
4	1979	92,700	.0381	39	1932	18,900	.5504
5	1966	66,800	.0527	40	1922	18,900	.5650
6	1969	54,700	.0674	41	1936	18,000	.5796
7	1948	51,800	.0820	42	1925	17,500	.5943
8	1978	50,600	.0966	43	1964	17,500	.6089
9	1965	46,200	.1113	44	1928	16,800	.6235
10	1916	46,200	.1259	45	1959	15,720	.6382
11	1974	43,500	.1405	46	1957	15,300	.6528
12	1975	42,800	.1552	47	1973	14,700	.6675
13	1970	39,600	.1698	48	1940	14,600	.6821
14	1956	33,800	.1844	49	1953	14,500	.6967
15	1967	33,600	.1991	50	1968	13,900	.7114
16	1962	33,400	.2137	51	1963	13,800	.7260
17	1976	32,900	.2284	52	1919	13,410	.7406
18	1972	30,700	.2430	53	1921	12,800	.7553
19	1960	30,500	.2576	54	1944	12,300	.7699
20	1943	29,500	.2723	55	1954	11,500	.7845
21	1945	29,400	.2869	56	1933	11,000	.7992
22	1949	29,200	.3015	57	1926	8,000	.8138
23	1947	28,400	.3162	58	1958	7,940	.8285
24	1942	27,900	.3308	59	1931	7,940	.8431
25	1941	27,800	.3455	60	1938	7,530	.8577
26	1920	26,700	.3601	61	1914	7,260	.8724
27	1951	26,600	.3747	62	1939	6,700	.8870
28	1971	26,600	.3894	63	1924	6,320	.9016
29	1923	26,000	.4040	64	1937	5,840	.9163
30	1917	25,900	.4186	65	1935	5,470	.9309
31	1913	25,600	.4333	66	1918	4,990	.9455
32	1952	24,200	.4479	67	1934	4,800	.9602
33	1946	24,100	.4625	68	1977	4,590	.9748
34	1955	24,000	.4772	69	1961	4,320	.9895
35	1930	20,800	.4918				

NOTE: Plotting positions based on 154 years (H) and 2 high values (Z).
Weight (W) for systematic values = 2.2687.


EXCEEDENCE FREQUENCY IN PERCENT
99.99 99.9 99.8 99.5 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05 0.01
DISCHARGE IN 1000 CFS
100
10
1
NOTES: ANNUAL INSTANTANEOUS PEAK FLOWS
WEIBULL PLOTTING POINTS
.05 CONFIDENCE
LIMIT CURVE
.95 CONFIDENCE
LIMIT CURVE
DISCHARGE-FREQUENCY CURVE
RED RIVER OF THE NORTH
AT GRAND FORKS, NORTH DAKOTA
PLATE 1



DISCHARGE-FREQUENCY CURVE
RED RIVER OF THE NORTH
AT OSLO, MINNESOTA

PLATE C-1-2

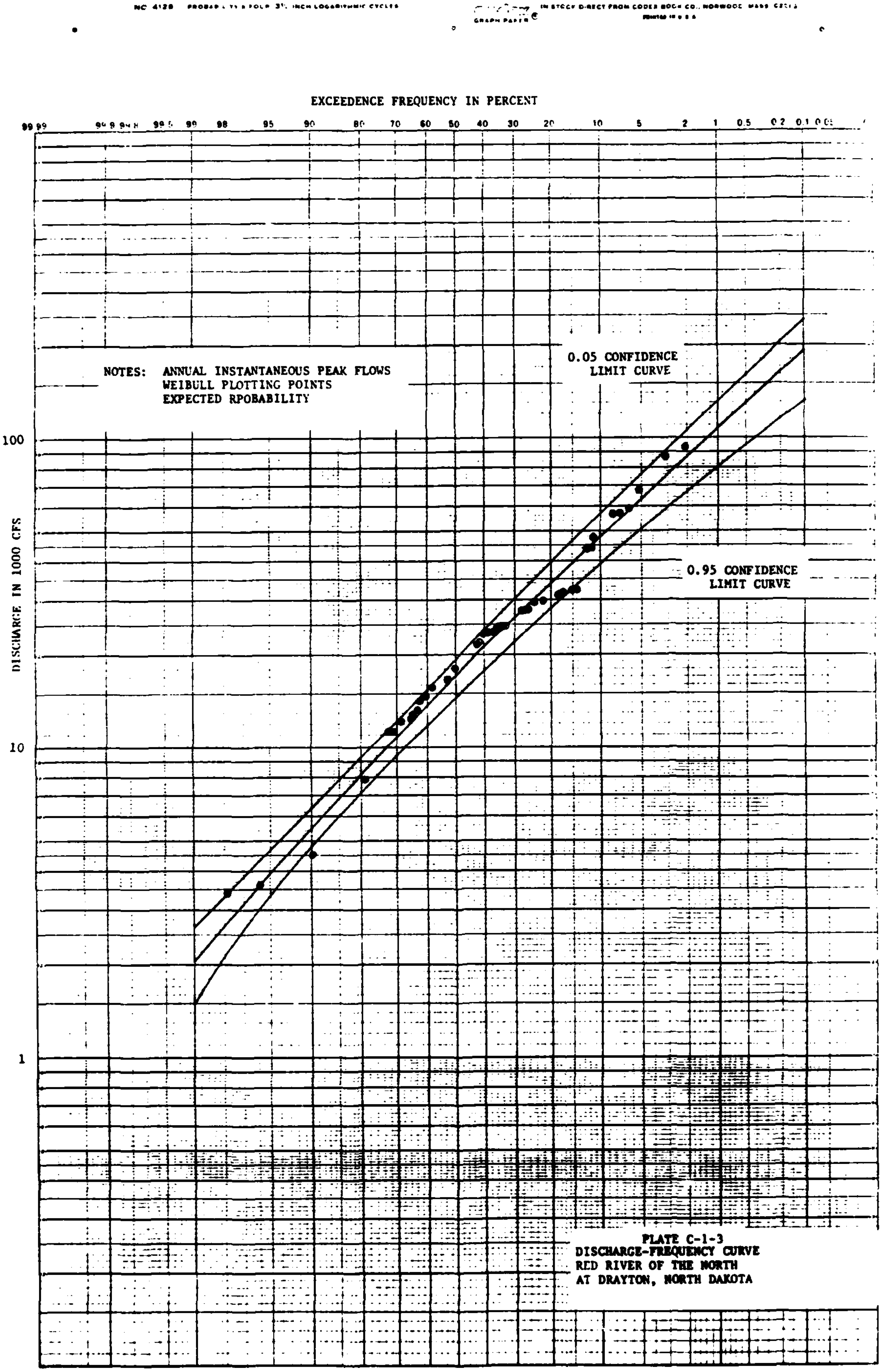


PLATE C-1-3
DISCHARGE-FREQUENCY CURVE
RED RIVER OF THE NORTH
AT DRAYTON, NORTH DAKOTA

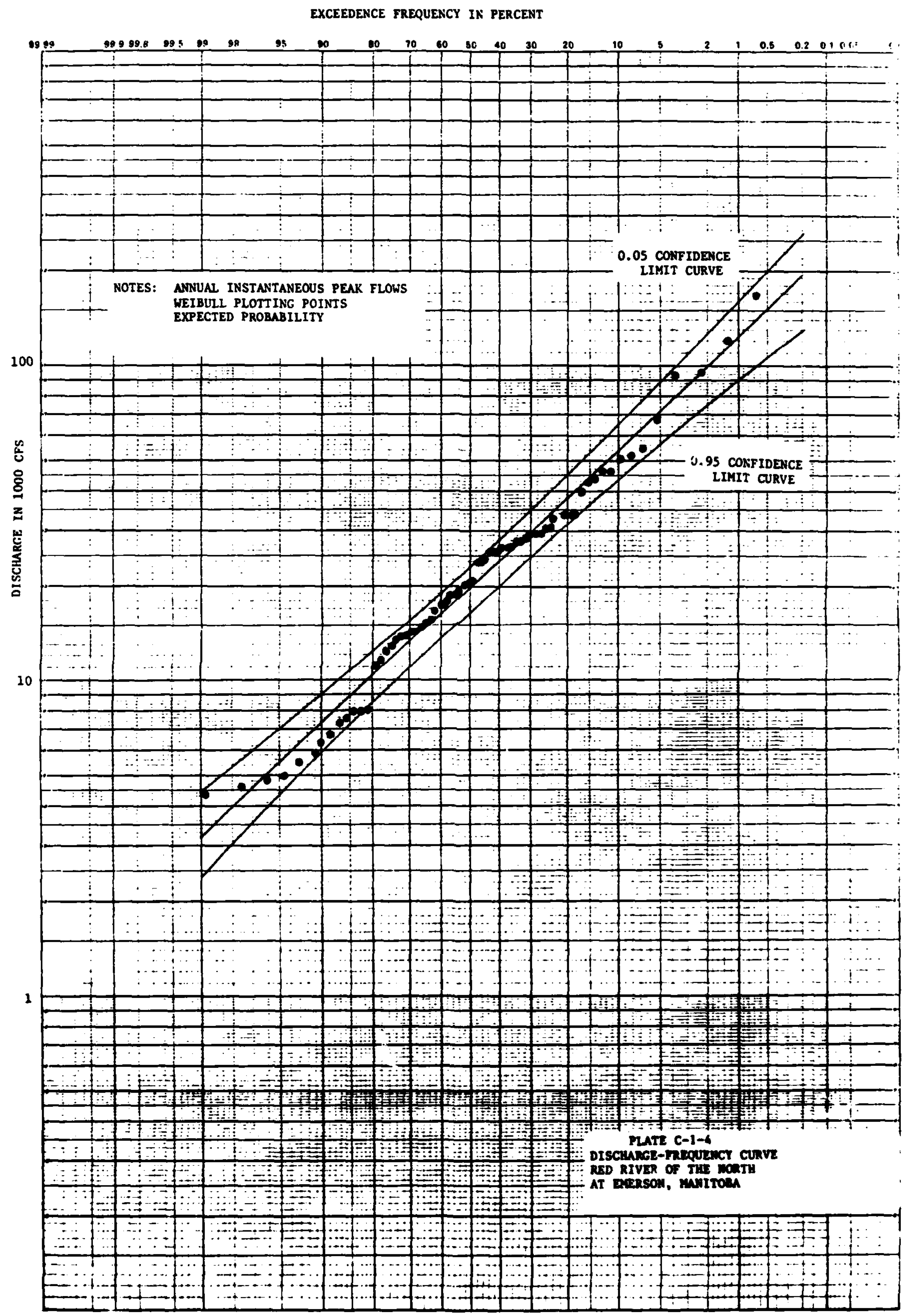


PLATE C-1-4
DISCHARGE-FREQUENCY CURVE
RED RIVER OF THE NORTH
AT EMERSON, MANITOBA

RATING CURVES

A rating curve is a graphical representation at specific river locations of the flow in cubic feet per second in the river versus the water surface elevation for various flood events. Topography, type of river bottom, restricted bridge openings, channel constrictions, ice, and other factors cause changes in channel discharges or water surface elevations affecting the rating curve. The rating curve uses data observed during a particular flood event and reflects the highest discharge and elevation that is recorded for that event. The rating curves for the Grand Forks, Oslo, Drayton, and Emerson gaging stations are given on pages C-1-16 through C-1-19, respectively. These plates identify several of the floods used in plotting the rating curve. A summary of the discharge and elevation information obtained from the rating curves for the 1-, 2-, 5-, 10-, 20-, and 50-percent chance floods is presented in table 1.

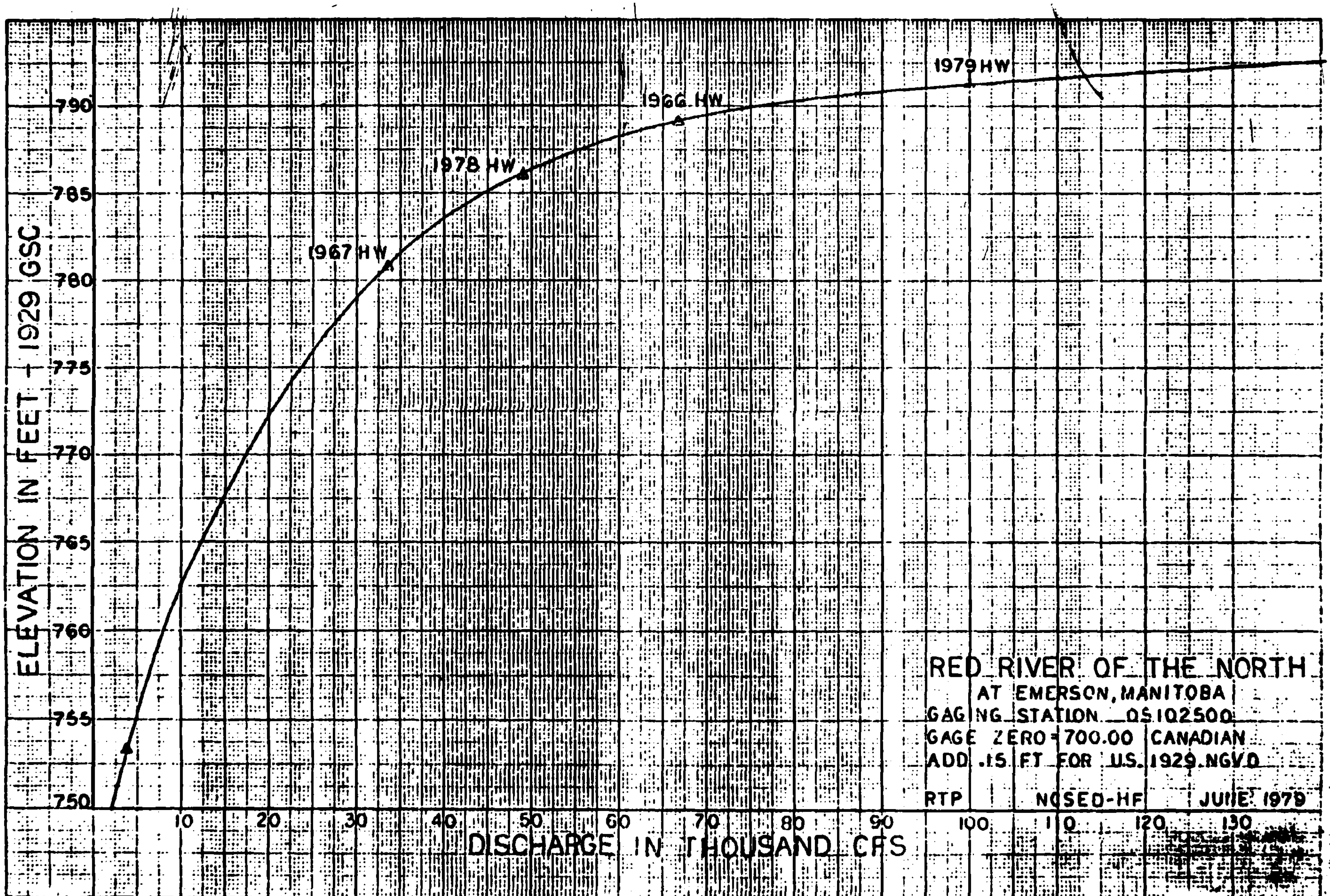
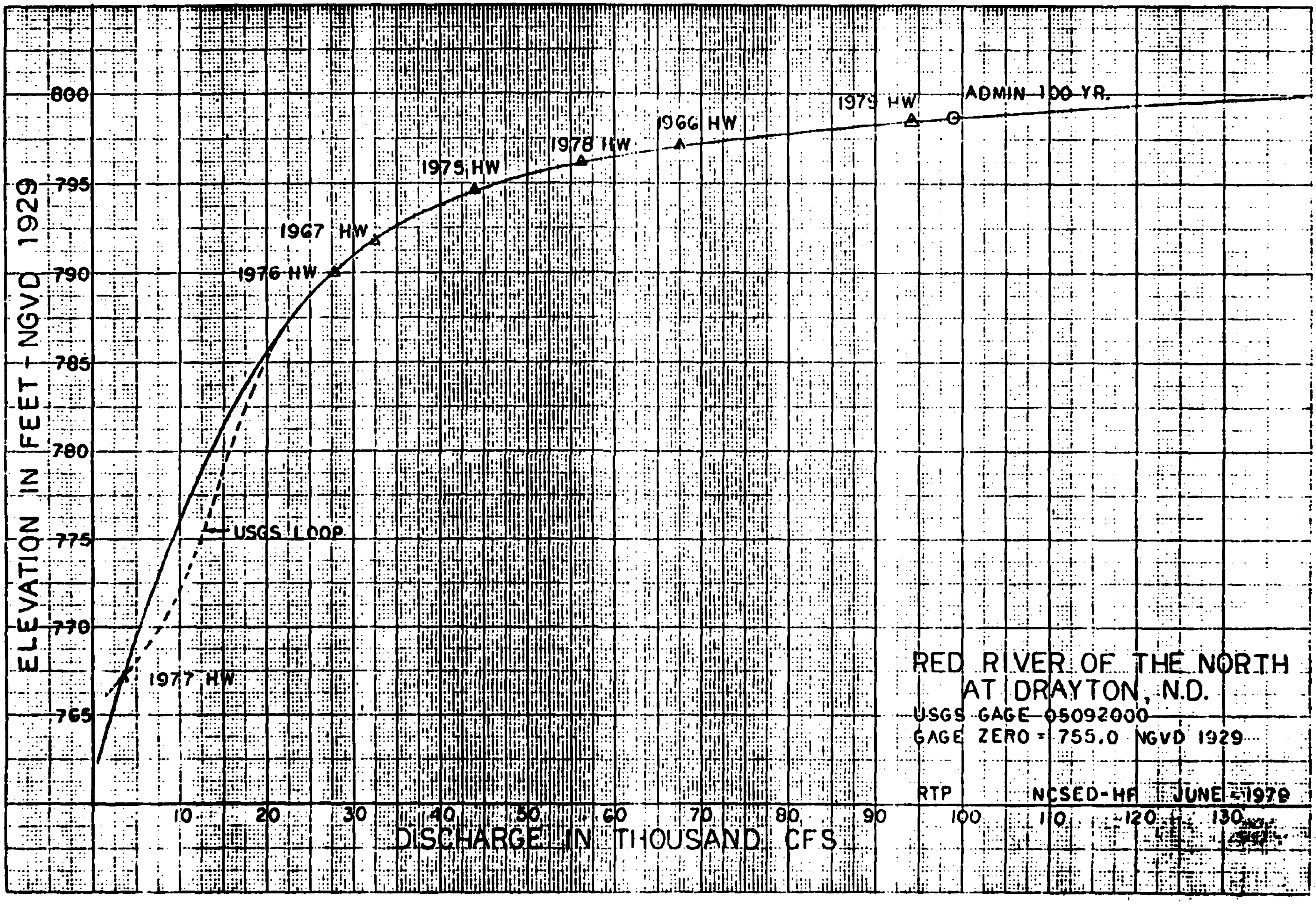
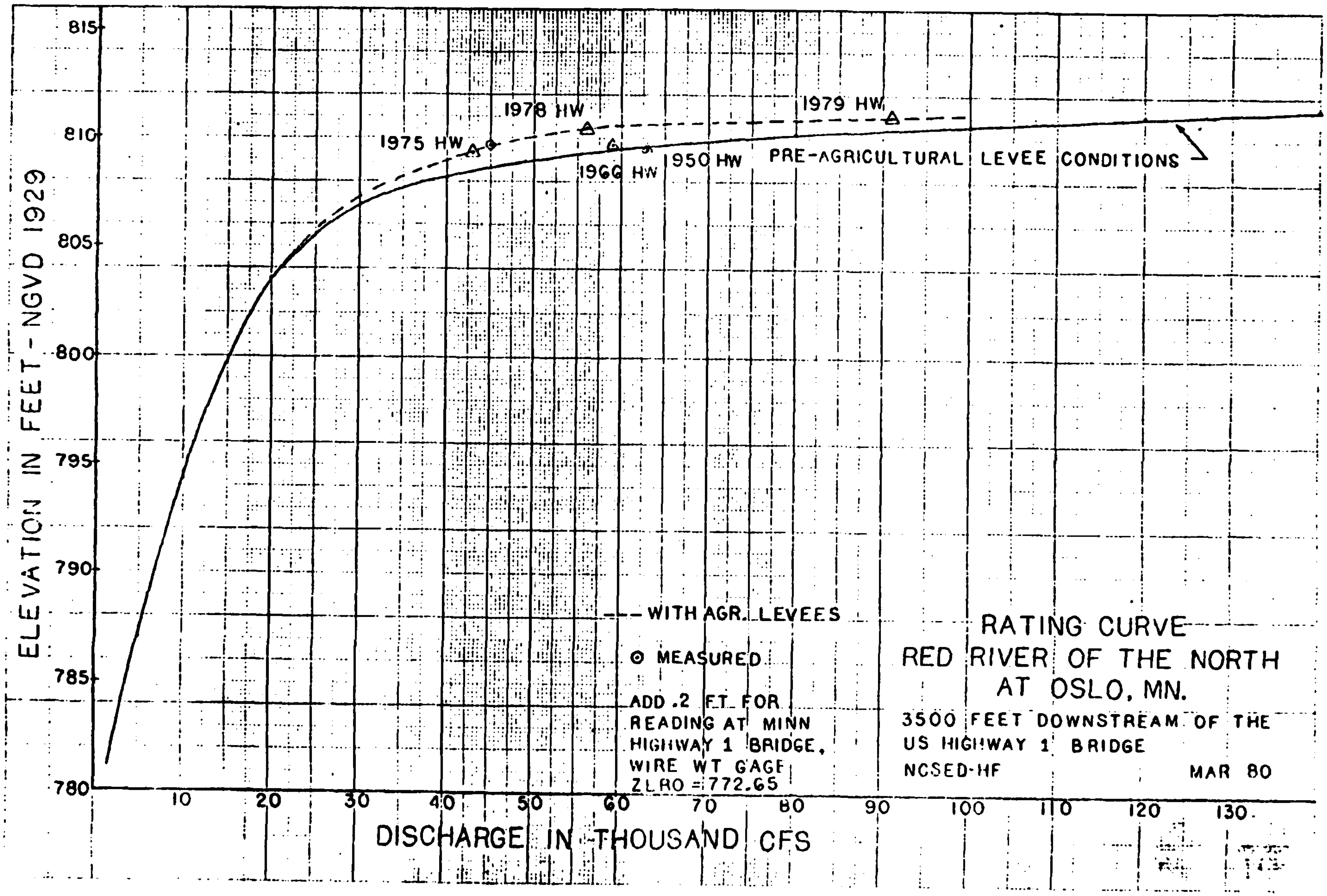

1979 HW
1966 HW
1978 HW
1967 HW
790
785
780
775
770
765
760
755
750
10
20
30
40
50
60
70
80
90
100
110
120
130
ELEVATION IN FEET - 1929 GSC
DISCHARGE IN THOUSAND CFS
RED RIVER OF THE NORTH
AT EMERSON, MANITOBA
GAGING STATION 05102500
GAGE ZERO = 700.00 CANADIAN
ADD .15 FT FOR U.S. 1929 NGVD
RTP
NCSED-HF
JUNE 1979

PLATE C-1-5



ELEVATION IN FEET - NGVD 1929
800
795
790
785
780
775
770
765
DISCHARGE IN THOUSAND CFS
10
20
30
40
50
60
70
80
90
100
110
120
130
ADMIN 100 YR.
1979 HW
1966 HW
1978 HW
1975 HW
1967 HW
1976 HW
USGS LOOP
1977 HW
RED RIVER OF THE NORTH
AT DRAYTON, N.D.
USGS GAGE 05092000
GAGE ZERO = 755.0 NGVD 1929
RTP
NCSED-HF
JUNE 1979

PLATE C-1-6



RATING CURVE
RED RIVER OF THE NORTH
AT OSLO, MN.
3500 FEET DOWNSTREAM OF THE
US HIGHWAY 1 BRIDGE
NCSED-HF
MAR 80
ELEVATION IN FEET - NGVD 1929
DISCHARGE IN THOUSAND CFS
815
810
805
800
795
790
785
780
10
20
30
40
50
60
70
80
90
100
110
120
130
1975 HW
1978 HW
1979 HW
1966 HW
1950 HW
PRE-AGRICULTURAL LEVEE CONDITIONS
WITH AGR. LEVEES
MEASURED
ADD .2 FT. FOR
READING AT MINN
HIGHWAY 1 BRIDGE,
WIRE WT GAGE
ZERO = 772.65

PLATE C-1-7

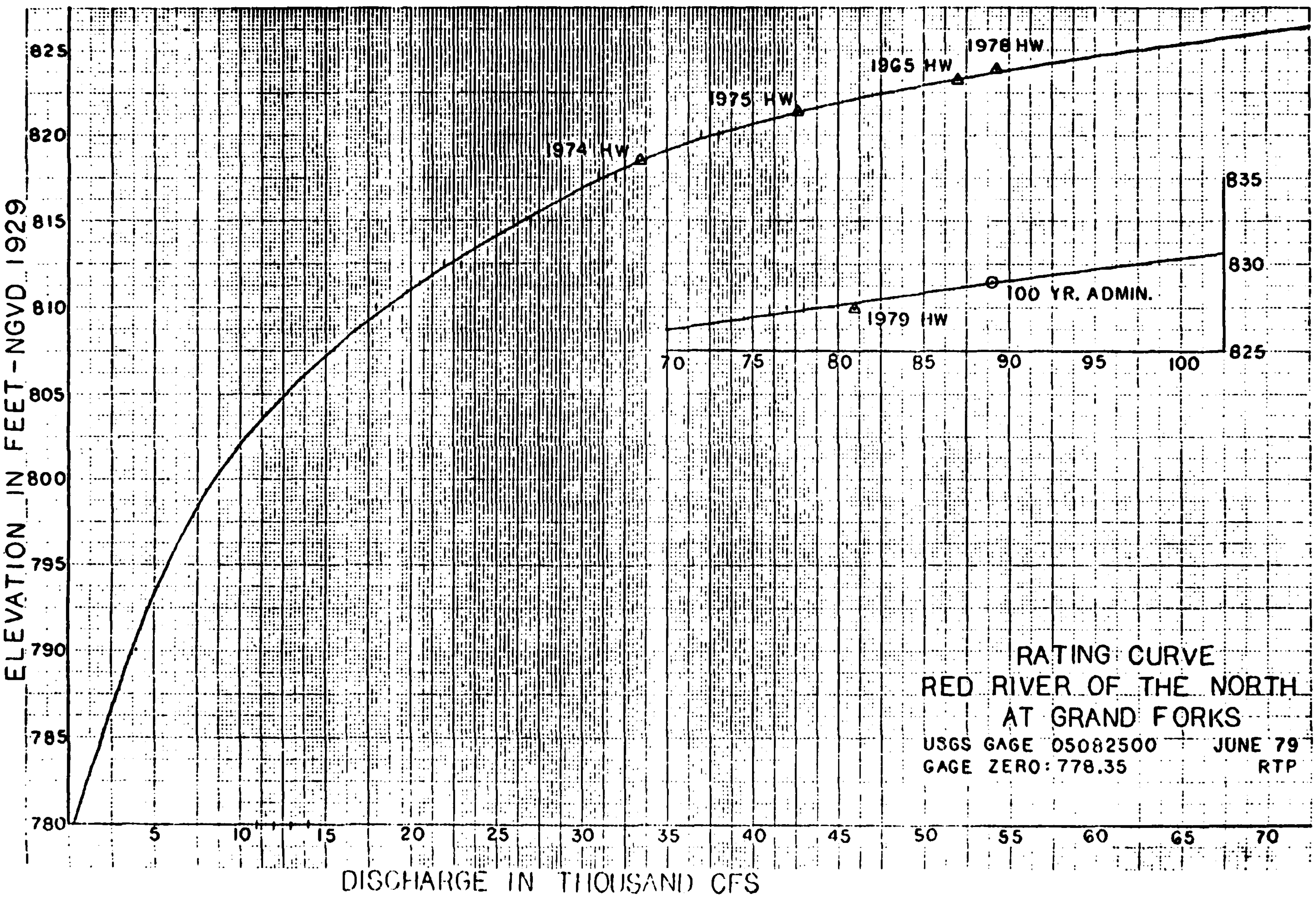

RATING CURVE
RED RIVER OF THE NORTH
AT GRAND FORKS
USGS GAGE 05082500
JUNE 79
GAGE ZERO: 778.35
RTP
ELEVATION IN FEET-NGVD 1929
DISCHARGE IN THOUSAND CFS
1974 HW
1975 HW
1965 HW
1978 HW
1979 HW
100 YR. ADMIN.
780
785
790
795
800
805
810
815
820
825
830
835
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100

PLATE C-1-8

WATER SURFACE PROFILES

A water surface profile graphically illustrates the elevation of a given flood along any given portion of the river. This profile is usually described in miles above the mouth of the river. The profiles for historic floods are developed on the basis of high-water data obtained by field observers (Corps of Engineers, U.S. Geological Survey, and local interests). Other flood profiles, such as the profile for the 1-percent chance flood, can be developed by systematically comparing estimates of hydrologic data at various gaging stations with those historic flood profiles. The profiles of the 1975, 1978, 1979, and 1-percent chance floods are presented in the following figure.

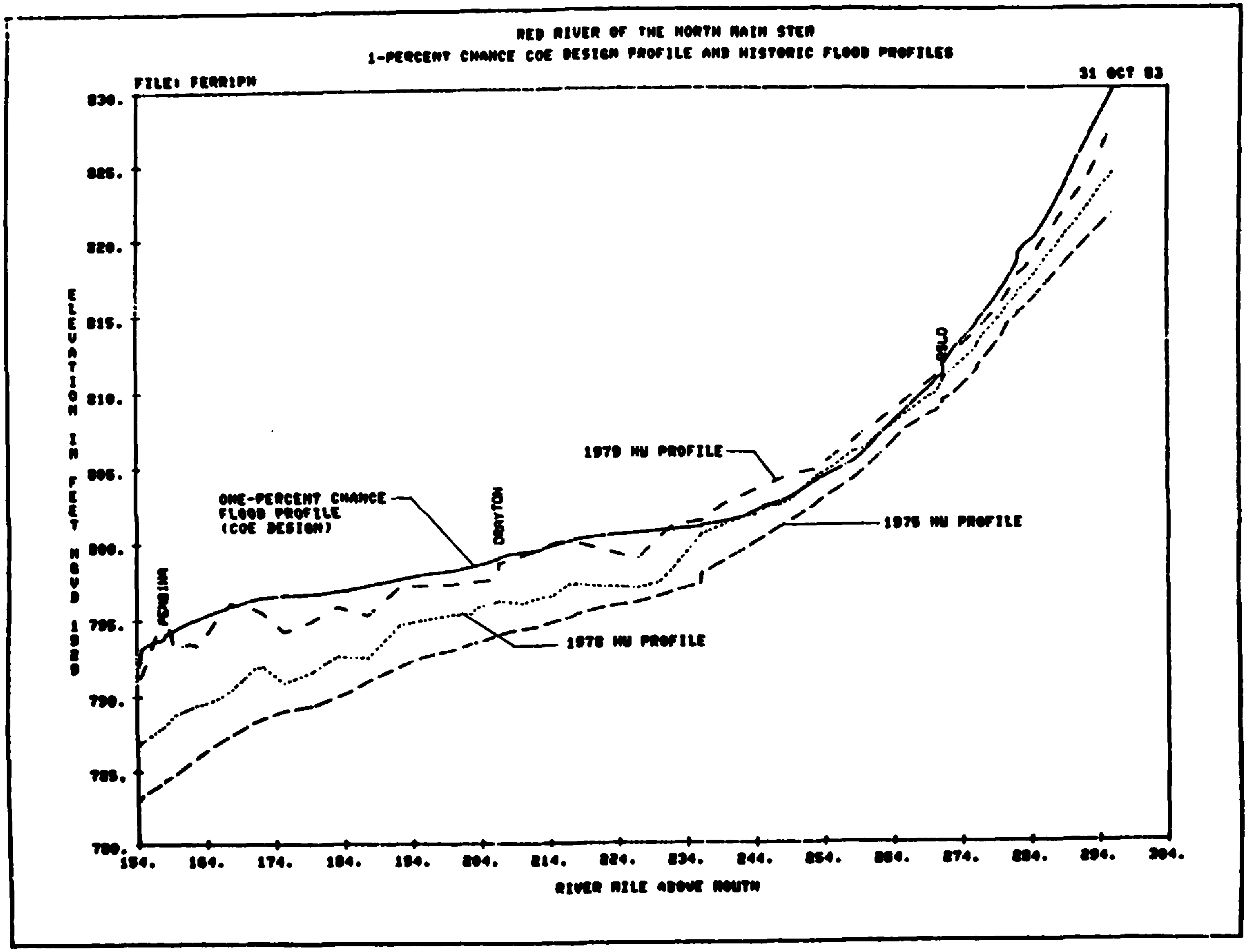

RED RIVER OF THE NORTH MAIN STEM
1-PERCENT CHANCE COE DESIGN PROFILE AND HISTORIC FLOOD PROFILES
31 OCT 83
ELEVATION IN FEET NGVD 1929
830.
825.
820.
815.
810.
805.
800.
795.
790.
785.
780.
154.
164.
174.
184.
194.
204.
214.
224.
234.
244.
254.
264.
274.
284.
294.
304.
RIVER MILE ABOVE MOUTH
PEMBINA
DRAYTON
OSLO
ONE-PERCENT CHANCE
FLOOD PROFILE
(COE DESIGN)
1979 HW PROFILE
1975 HW PROFILE
1978 HW PROFILE

PLATE C-1-9

APPENDIX C

TECHNICAL INFORMATION

SECTION 2

GEOTECHNICAL DESIGN INFORMATION

SECTION 2

GEOTECHNICAL DESIGN INFORMATION

TABLE OF CONTENTS

SECTION 2
GEOTECHNICAL DESIGN INFORMATION

GENERAL GEOLOGY

The Red River is the lakebed of glacial Lake Agassiz, which covered the area during the retreat of the last glacier from the region. As the glacier receded, it formed a barrier to northward drainage and created the lake. Rivers, swollen with water from the melting glaciers, carried large quantities of sediment into the lake. The coarse sediments were deposited as deltas and worked into beach lines near shore. The fine silts and clays were carried out into the lake where they settled and formed deposits up to 150 feet thick. As the ice barrier melted, the northward drainage was reestablished, and sediments were exposed to weathering and erosion. The Red River and its tributaries cut steep-sided meandering channels into the nearly level, soft lake sediments and formed a meander belt without a well-developed floodplain. Slopes from the lake plain to the river's edge are undeveloped and covered with a dense growth of brush and timber. These banks are heavily scarred with old slides and sloughs.

GEOLOGIC COLUMN

The materials in the area are easily recognized and correlated with materials found elsewhere in the Lake Agassiz basin. Four major soil types are present within the project area: fluvial (river-deposited) sediments, two types of lacustrine (lake-Deposited) sediments, and sediments deposited by glacial ice.

The glacial sediments underlie the lacustrine clays throughout the region and represent the original bottom of Lake Agassiz before filling began. These sediments are characteristically more competent than the other three soil units. No evidence of failures exists within these materials.

The lower lacustrine sediments, or dark gray clays, are present throughout the are. This soil type is extremely weak and is primarily responsible for the region's notoriously poor foundation characteristics. The unit is thicker outside than within the meander belt, where the river has partially eroded it.

The upper lacustrine sediments (laminated silty clays) are not as thick as the lower lacustrine sediments. These laminated silty clays may be found at or near the surface outside the meander belt or may be buried by thick fluvial deposits within the meander belt. This soil type is only slightly stronger than the dark gray clays.

The fluvial sediments (river deposits) are the youngest in the region and are restricted in significant distribution to the meander belts of rivers. Fluvial sediments consist of discontinuously stratified and mixed deposits of silt and clay. These deposits are the strongest within the zone of influence for sliding.

PAST GEOTECHNICAL PROBLEMS

Within this century, many foundation failures have occurred along the Red River. The most famous were at the Transcona Grain Elevator in Manitoba and the Great Northern Railway Bridge in Grand Forks. Other serious problems occurred during or relatively soon after construction of all types of structures including buildings, roadways, and levees.

Failure of existing riverbanks frequently occurs without any apparent increase in riverbank loading. Such failures indicate that in many cases the stability of the riverbank is so marginal that minor changes in existing conditions are sufficient to initiate failure. Because of the history of riverbank failures throughout the Red River Valley, it is commonly recommended that additional loading of the riverbanks be avoided to the maximum practical extent. Wherever increased riverbank loading is

proposed, extensive subsurface investigation and stability analysis are required to determine if, in fact, the loading can be applied with a sufficient margin of safety to avoid causing riverbank instability. Such investigations are very expensive and generally end up showing that the existing banks without any loading have a factor of safety against sliding of just slightly greater than 1.0

DESIGN ALTERNATIVES

Farmstead flood protection could consist of any or all of the following flood barrier alternatives: ring levees, floodwalls, or relocation or raising in-place of homes and/or grain bins for placement on earth fill (termed "padding" by the Soil Conservation Service).

RING LEVEES

The ring levees, if judged adequate with respect to stability, would consist of impervious material constructed with a minimum 10-foot top width and 1V on 3H side slopes. Final location of levees, interior drainage, and access roads will be coordinated with the owner to obtain an acceptable layout which meets design standards. Some ring levees have been constructed by property owners since the 1979 flood of record and generally incorporate the entire farmstead. These levees do not meet the above minimum requirements but may be incorporated into the proposed levee prism.

General conclusions can be made from previous experience with levee construction in the project area. Levees should not be considered for flood barriers when the levee location would be closer than about 300 feet from the riverbank. Out of 182 farmsteads in this study, about 60 are considered too close to the river to construct only an earth ring levee. Some other design features could be used to supplement the earth levees where complete levees cannot be practically developed. These include floodwalls and padding.

FLOODWALLS

The required setback distance from the riverbank to the levee could be reduced by using some form of a floodwall (in lieu of a levee) that would apply a smaller increase of loading on the existing banks. However, at most locations, this change in setback distance will probably be relatively small (less than 50 feet). Inexpensive floodwalls such as Armco steel bins filled with earth could be considered for relatively short reaches of barriers.

PADDING

Padding or raising of structures on earth fills constructed to a design elevation is a viable alternative to flood barrier protection especially in areas where placement of levees would cause bank instability.

Alternative solutions will need to be determined individually for each farmstead based on engineering analysis, cost comparisons, and property owner desires.

ANTICIPATED DESIGN REQUIREMENTS

Additional field work will be required in areas where farmsteads are near the Red River or its tributaries. Selective surveys, borings, and testing will be completed as necessary to adequately design flood protection measures. The cost of such investigations, including stability analysis, is estimated at about $10,000 to $20,000 per site. It is anticipated that one investigation could be made representative for several similar sites.

APPENDIX C

TECHNICAL INFORMATION

SECTION 3

ECONOMICS

SECTION 3

ECONOMICS

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TABLES (cont)

FIGURES

SECTION 3
ECONOMICS
INTRODUCTION

This section presents a comprehensive treatment of the socioeconomic environment within Walsh and Pembina Counties, North Dakota. In addition, a preliminary economic study is included which determines the extent of potential flood damages, establishes average annual flood damages, and estimates the potential for economic feasibility of the various identified alternatives.

ECONOMIC CHARACTERISTICS

POPULATION

The populations of Pembina and Walsh Counties have been steadily decreasing in recent decades. Farm population, which represents a major portion of the total population, has been decreasing as the demand for farm labor has decreased. In Pembina County, farming was the principal occupation of the operator on 843 farms in 1974 and on 825 farms in 1978 while in Walsh County farming was the principal occupation of the operator on 1,099 farms in 1974 and on 1,029 farms in 1978. Demand has decreased because of increased farm mechanization and consolidation. Consequently, people moved from the rural areas to the urban areas in search of employment. The larger towns, Cavalier and Drayton in Pembina County and Grafton and Park River in Walsh County, have experienced a general increase in population since 1950. The population of the largest city in the area, Grand Forks, has increased significantly from 1950 to 1980 (26,836 to 43,765). Population figures for the counties and towns within the counties are presented in table 1.

Table 1 - Populations of Pembina and Walsh Counties, 1950-1980

City or County	Year 1950	1960	1970	1980
Pembina County	13,990	12,946	10,728	10,399
Walsh County	18,859	17,997	16,251	15,371
Cities in Pembina County				
Cavalier	1,459	1,423	1,381	1,505
Drayton	875	940	1,095	1,082
Hamilton	241	217	110	109
Neche	615	545	451	471
Pembina	640	625	741	673
St. Thomas	566	660	508	528
Cities in Walsh County				
Forest River	236	191	169	152
Grafton	4,901	5,885	5,946	5,293
Minto	592	642	636	592
Park River	1,692	1,813	1,680	1,844

Source: Statistical Abstract of North Dakota - 1983.

Pembina and Walsh Counties are within the non-SMSA portion of the Grand Forks BEA Economic Area. OBERS projections of population for this area are shown in table 2.

Table 2 - Population Projections of Non-SMSA Portion of Grand Forks BEA Economic Area

Year	1969	1978	1985	1990	2000	2030
Population	67,921	66,339	67,268	69,136	71,438	80,443

Source: 1980 OBERS BEA Regional Projections, Vol 7.

EMPLOYMENT

For the past few decades, on-farm employment has been decreasing due primarily to the decreasing number of farms and increasing substitution of farm machinery for labor. Employment in that sector has increased, however, because of an increase in agricultural services in the area. Employment for nonagricultural sectors has increased, particularly services, manufacturing, and wholesale and retail trade. From 1970 to 1980, total employment has increased in Pembina County from 3,238 to 4,083 (26 percent) and in Walsh County from 5,238 to 5,765 (10 percent). Employment by industry for the two counties is shown in table 3.

Table 3 - Employment Characteristics for Pembina and Walsh Counties, 1970-1980

Item	Pembina County 1970	Pembina County 1980	Walsh County 1970	Walsh County 1980
Total employment	3,238	4,083	5,238	5,765
Agriculture, (1) forestry, fisheries and mining	745	1,031	1,335	1,515
Construction	150	207	241	366
Manufacturing	331	394	211	188
Transportation, communications and utilities	236	239	377	369
Wholesale trade	71	197	358	292
Retail trade	599	730	838	1,052
Finance, insurance and real estate	147	134	136	180
Services	757	961	1,577	1,637
Public administration	202	190	165	166
Unemployment				
Number of people	131	232	233	347
Percent of labor force	3.9	5.4	4.3	5.7

(1) Includes agricultural services as well as farming.

Future employment trends for the area can be seen in the OBERS projections in table 4. Farm employment is projected to continue decreasing while the nonfarm sectors are projected to continue increasing.

Table 4 - Employment Projections of Non-SMSA Portion of Grand Forks BEA Economic Area

Employment	1969	1978	1985	1990	2000	2030
Total Employment	25,737	30,520	32,308	33,143	34,774	36,294
Farm	7,617	6,563	5,872	5,505	5,005	4,075
Nonfarm	18,120	23,957	26,436	27,638	29,769	32,219
Ag services, forestry, fisheries, and mining	(D)	(D)	(D)	(D)	(D)	(D)
Construction	1,007	1,777	1,798	1,767	1,750	1,715
Manufacturing	835	1,287	1,509	1,649	1,940	2,371
Transportation and utilities	755	1,148	1,229	1,241	1,284	1,309
Wholesale trade	668	(D)	(D)	(D)	(D)	(D)
Retail trade	4,151	4,609	5,115	5,365	5,809	6,248
Finance, insurance, and real estate	524	898	1,079	1,176	1,343	1,585
Services	3,498	(D)	(D)	(D)	(D)	(D)
Government	6,486	6,835	6,966	6,978	7,067	7,032

(D) Deleted to avoid disclosure of confidential information; data are included in totals.

Source: 1980 OBERS BEA Regional Projections

INCOME

Total personal income has increased between 1970 and 1980 for both Pembina and Walsh Counties. On a percentage basis, though, the increase was less than the State as a whole (see table 5). Farm income accounts for more than half of the total personal income, and cash grain sales amount to more than 70 percent of the total farm income. During the same period, per capita income of the counties has increased as well, but again, less than the State on the whole (see table 6). Projections of total personal income for the BEA Economic Area are presented in table 7. Although there has been an upward trend in both total and per capita income, fluctuating farm prices are the primary determinants of income changes from year to year.

Table 5 - Total Personal Income (In Millions of Dollars)

Area	1970	1980	Percentage of Change
North Dakota	1,904.0	5,643.0	+196.4
Pembina County	33.5	86.7	+158.8
Walsh County	47.7	114.0	+139.0

Table 6 - Per Capita Income (In Current Dollars)

Area	1970	1980	Percentage of Change
North Dakota	3,216	8,626	168.2
Pembina County	3,109	8,320	167.6
Walsh County	2,930	7,397	152.5

Source: Statistical Abstract of North Dakota, 1983.

Table 7 - OBERS Projections of Total Personal Income for Non-SMSA Portion of Grand Forks BEA Economic Area

Year	1969	1978	1985	1990	2000	2030
Total Personal Income (thousands of 1972 dollars)	216,522	340,184	407,465	471,633	615,466	1,222,444

Source: 1980 OBERS BEA Regional Projections, Vol 7.

AGRICULTURE

Agriculture is the most important economic activity in both Pembina and Walsh Counties. The counties rank high in the production of small grains compared to the rest of the State. Livestock is less important to their economy but they do rank in the top third in hog production. Table 8 shows their rank in the production of various agricultural products in North Dakota (of 53 counties).

Table 8 - Rank of North Dakota's Counties (1980)

County	Wheat	Barley	Cattle	Hogs
Pembina	3	11	48	14
Walsh	8	7	42	17

Source: North Dakota Agricultural Statistics, 1981.

Table 9 identifies the major crops in the counties and the total production.

Table 9 - 1980 Crop Statistics, Pembina and Walsh Counties

Crop	Harvested Acres	Yield Per Acre	Total Production
Pembina County			
Barley	45,500	38.2 bu.	1,738,000 bu.
Beans	34,500	1,500 bu.	51,750,000 bu.
Potatoes	26,000	150 cwt.	3,900,000 cwt.
Sugar beets	24,100	17.3 tons	417,400 tons
Sunflowers	69,000	990 lbs.	68,517 lbs.
Wheat	265,800	26.0 bu.	6,909,100 bu.
Walsh County			
Barley	56,000	32.5 bu.	1,818,000 bu.
Beans	30,500	990 bu.	30,272,000 bu.
Potatoes	53,300	140 cwt.	7,462,000 cwt.
Sugar beets	26,500	13.6 tons	361,400 tons
Sunflowers	54,000	870 lbs.	46,988 lbs.
Wheat	277,700	21.2 bu.	5,882,500 bu.

Source: North Dakota Agricultural Statistics, 1981.

As stated earlier, the number of farms in Pembina and Walsh Counties has been decreasing while the average size of the farms has been increasing. Table 10 illustrates this trend.

Table 10 - Number and Average Size of Farms - 1969 and 1978

County	Number of Farms		Average Size of Farms	
	1969	1978	1969	1978
Pembina	1,065	946	630	720
Walsh	1,415	1,172	592	707

Source: Census of Agriculture, 1969 and 1978.

MANUFACTURING

There are nine manufacturing establishments in Pembina County and eleven manufacturers in Walsh County. The majority of these establishments manufacture agricultural-related products with the exception of a bus manufacturer in Pembina County. Manufacturing employment constitutes 10 percent of the total employment in Pembina County and only 3 percent of the total employment in Walsh County.

GENERAL ECONOMIC EVALUATION PROCEDURES

National economic evaluations provide part of the justification for recommendations for Government expenditures. With few exceptions, water resource projects must be justified based on economic feasibility. The determination of the economic feasibility of any proposed alternative, such as the Red River farmstead ring levees, consists of assessing project costs as compared to the project benefits. Total benefits must equal or exceed project costs.

Estimating the cost of an alternative is a relatively straightforward procedure, consisting basically of estimating the overall construction costs and the annual operation, maintenance, and replacement costs associated with the project. Flood control benefits, however, involve consideration of many more variables and result in greater evaluation detail, particularly for agricultural evaluation. In addition, costs of protection (except for maintenance) are incurred all at once while benefits will accrue over the entire project life. Thus, the annualization of costs and benefits must be spread equivalently over the project life to accomplish a legitimate economic comparison. The Federal interest rate is used to recapture project costs and benefits on an annual basis. In addition, the same price level must be used for both costs and benefits.

The method for determining average annual damages and benefits (e.g., farmstead protection) considers all of the floods, both small and large events, that can reasonably be expected to occur over the life of the project. This is accomplished for farmsteads by determining (1) the dollar damages related to various streamflows or elevations, (2) the probability of floods of all sizes occurring in any given year (the smaller the flood, the more frequent the chances of recurrence), and (3) the average annual losses.

ECONOMIC ASSUMPTIONS

The following assumptions were made in evaluating the various alternatives:

1. One hundred eighty two farmsteads are considered to be inhabited operational farmsteads where the residents run a viable farming operation and live on the farmstead. This number was screened from the 354 farmstead total within the study area using the following criteria.

a. Only inhabited operational farmsteads will be eligible for Corps-sponsored construction of flood damage reduction measures. In future studies, however, consideration will be given to moving other floodplain granaries and buildings to inhabitable farmsteads.

b. Farmsteads must be a small business to be considered. Those that consist of only a house or only farm buildings are not eligible for Corps-sponsored construction of flood damage reduction measures.

c. Inhabited operational farmsteads that are located near a river, where it is not feasible to construct a farmstead ring levee because of soil stability problems, may be eligible for another economically feasible method of flood damage reduction.

d. Farmsteads that are outside the 100-year floodplain are not eligible for Corps-sponsored flood damage reduction measures.

2. Wheat was considered to be the primary stored agricultural product of farms in the study area. Grain is destroyed by floodwater to a level 1 foot above floodwater depth in the granary.

3. The price of wheat was considered to be $4.34 per bushel, which is the 1982 current normalized price.

4. The interest rate is 8-1/8 percent for October 1983 price levels.

5. Economic evaluations were made for the 20-, 50-, and 100-year floodplains.

6. The damage-frequency curves were drawn for each floodplain using the water surface profiles for the 10-, 20-, 50-, 100-, and 500-year floods and flood damages determined by field survey of the structures. These water surface profiles were used assuming a baseline hydraulic and economic condition of no agricultural levees in place. The rationale for this is presented in the main report.

7. Only one reach from Oslo to Pembina was identified. This reach, however, was analyzed further on a floodplain basis.

ECONOMIC EVALUATION OF FLOOD DAMAGES

In June 1981, a massive data collection effort was instituted by the Corps of Engineers to inventory every unit (i.e., structure) in the 100-year floodplain downstream of Grand Forks. Much of this area had been inventoried under subbasin studies but at different times, representing different development conditions. A more uniform base was needed to provide the best possible analysis and assess the impacts of various proposed actions. By October 1982, the economic update was complete. This update included an inventory, interview, and survey of each of the farmsteads within the study area. Information collected included size of farmstead, type and number of grain storage bins, presence or absence of additional buildings, building valuations, ground surface or first floor elevations of each significant structure, flood damages experienced for the 1975, 1978, and 1979 floods, and additional data on social and economic impacts from flooding. This information was combined with information provided by local representatives of the U.S. Department of

Agriculture and information collected from past studies within the general study area to estimate agricultural farmstead damages. This information is presented herein.

Farmstead damages for the 1975, 1978, and 1979 floods were identified from interviews and verified based on computed damages using water surface profiles and collected data. Information was divided into the 20-, 50-, and 100-year floodplain delineations, and corresponding elevation-damage curves were established for each.

Damages to farmsteads within the agricultural sector of the study area include the following categories, as shown in table 11.

Table 11 - Farmstead Damage Categories

Category	Approximate(1) percent of on-farm damages
Loss or spoilage of stored grain and hay	32
Building damage and cost of repair and replacement of furnishings	50
Debris cleanup around farmstead	3
Costs of evacuation of residence and family	6
Machinery damage and repair or replacement	8
Livestock loss or changes in livestock productivity	1
	100

(1) Percentage exchange slightly for different levels of flooding.

Table 12 shows probable farmstead damages per floodplain at various historic frequencies.

Table 12 - Probable Farmstead Damages at Various Frequencies

		Flood event and frequency		
		1975	1978	1979
Floodplain	Damage category	14.0 percent	7.5 percent	1.3 percent
20-year	Farmstead damage	$341,651	$1,208,162	$2,155,688
	Farmstead units	98 units	98 units	98 units
50-year	Farmstead damage	$357,630	$1,341,868	$2,377,523
	Farmstead units	118 units	118 units	118 units
100-year	Farmstead damage	$485,082	$1,600,041	$3,209,945
	Farmstead units	182 units	182 units	182 units

Zero-damage point is at the 3.8-year event/26-percent frequency.

FUTURE FLOOD DAMAGES

Although future flood damages were not calculated as part of this reconnaissance evaluation, flood damages are expected to increase in the future. The potential exists for farmstead residential damages to increase by an affluence factor (which is a projected rate of increase in damagable contents over time) and for damages to stored crops to increase as more harvested grain is stored on each farmstead site.

Presently, damage to stored crops represents 32 percent of on-farmstead damage. It is noteworthy that on-farm storage of wheat, barley, and oats has almost tripled since 1975. On-farm storage represents approximately 83 percent of all storage of dry grains (primarily wheat, barley, and oats) in the Red River Valley. Storage capacity for these crops in the counties bordering the Red River totals 316,433,000 bushels (source: Grain Storage Capacity Survey, October 1979, U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service). This capacity is approximately equal to 1-1/2 year's production of these three

crops in the valley. The capacity is enough to store 11 percent of the United States 1978 production of these three crops. When storage bins are flooded, spoilage is recorded for more grain than merely that inundated. Oats and barley inundated while in storage will spoil the entire bin. Wheat will spoil 1 foot beyond the maximum height of the water. In summary, if all or most of the grain storage bins are full, a tremendous damage potential exists in the study area that is presently only partially accounted for.

EVALUATION OF BENEFITS

Flood damage reduction benefits were evaluated for each of the identified alternatives. The benefits were graphically computed by comparing the difference in average annual damages between the existing and modified (with alternative in place) conditions. The flood control benefit analysis is shown in tables 13 through 15.

Although it was not done for this reconnaissance evaluation, freeboard benefits can be taken for one-half of the freeboard on the farmstead ring levee alternative. Consideration will be given to this item in future study efforts.

BENEFIT-COST ANALYSIS

Costs of the alternatives were determined using the information provided on pages C-3-16 through C-3-19. These costs were based on cost data available for similar work throughout the Red River region.

To determine the economic viability of the alternatives, benefits and costs were compared for each alternative, and a benefit-cost ratio was calculated as shown in tables 13 through 15.

The benefits and costs for three of the four alternatives considered in the study are summarized below. No benefit-cost analysis was accomplished for the flood forecasting, warning, and evacuation alternative since that alternative would be implemented either with or without a project.

Table 13 - Benefits and Costs for Farmstead Ring Levee Alternatives

Item	Amount ($)		
	20-year	50-year	100-year
Average annual costs	86,123	183,199	335,225
Average annual benefits	171,800	189,100	282,100
Benefit-cost ratio	2.00	1.03	0.84

Table 14 - Benefits and Costs for Raising Farmstead Buildings

Item	Amount ($)		
	20-year	50-year	100-year
Average annual costs	110,039	131,079	200,864
Average annual benefits	140,876	155,062	231,322
Benefit-cost ratio	1.28	1.18	1.15

Table 15 - Benefits and Costs for Floodproofing

Item	Amount ($)		
	20-year	50-year	100-year
Average annual costs	172,935	208,230	321,185
Average annual benefits	140,876	155,062	231,322
Benefit-cost ratio	0.81	0.74	0.72

SENSITIVITY ANALYSIS

A sensitivity analysis was not completed as part of the reconnaissance evaluation. However, future study efforts will include such an analysis to evaluate what might be the effects on the benefits if specific changes are made in the basic assumptions. Items that could be considered are:

a. Interest rates.
b. Increasing crop prices for stored grain.
c. Growth in damages.

COST ESTIMATES

FARMSTEAD RING LEVEES

Flood protection costs for the farmstead ring levee alternative were determined by using the following unit prices:

Item	Unit	Unit price
Clearing	Acre	$1,500
Stripping, 6 inches	Cubic yard	1
Levee fill	Cubic yard	1
Seeding	Acre	200
CMP, 24-inch diameter	LF	26
Slide gate, 24-inch diameter	Each	400
Land	Acre	1,000
Interior drainage	Each	1,400

The above prices are typical of construction costs in the northeastern area of North Dakota and reflect current economic conditions in the study area.

First costs were determined for each of the 182 inhabited operational farmsteads using the above unit prices, a 30-percent contingency factor, and farmstead size using available photographs. Total costs were then calculated for each floodplain area by applying a 15-percent cost for engineering and design, 25 percent of the engineering and design cost for inspection, and 25 percent of the inspection costs for overhead. Average annual costs were determined based on the 8-1/8-percent interest rate and an operation and maintenance cost of $500.

RAISING BUILDINGS

Flood protection costs for raising buildings an average of 4 feet were determined by using the following unit prices:

Item	Unit	Unit price
Raising house	Square foot	$ 2.50
Raising barn	Square foot	1.00
Raising machine shed	Square foot	1.50
Raising mobile home	Each	150.00
Raising silos	Each	500.00
Raising garage	Each	200.00
Raising grain bins	Each	150.00

Photographs and depth of flooding information of the farmsteads were used to determine which buildings would be raised. The first cost for raising the buildings on each farmstead was then determined using the above prices and applying a 30-percent contingency factor. The total project cost for each floodplain area included the first cost plus a 15-percent cost for engineering and design, 25 percent of the engineering and design cost for inspection, and 25 percent of the inspection costs for overhead. Average annual costs were determined based on the 8-1/8-percent interest rate and a maintenance cost of $500.

FLOODPROOFING

Costs to floodproof farmstead buildings were determined by using the following unit prices:

Item	Unit	Unit price
Raise house to expose foundation	Each	$ 500
Excavate foundation, construct new reinforced foundation and backfill for 38x40-foot house	Each	4,300
Install damp-proof membrane around foundation of 38x40-foot house	Each	625
Move furnace and other appliances from basement to first floor and reconnect	Job	750
Install water-tight doors	Job	300
Fill windows to above floodline	Job	200
Install one-way check valves on sinks	Job	95
Seal first 3 feet of outside walls	Job	350
Remove electrical equipment from basement and reconnect	Job	1,150
Remove plumbing from basement and reconnect	Job	1,150
Seal 20-foot diameter round metal grain bins on concrete pads	Each	200
Total/house		$10,000

The total cost to floodproof each house is $10,000. The cost to floodproof the 98 farmsteads in the 20-year floodplain is $1,689,030 which was determined in the following manner:

98 farmsteads X $10,000/farmstead =	$ 980,000	
	294,000	30-percent contingency
	1,274,000	subtotal
	191,100	15-percent engineering and design
	47,750	25-percent inspection
	11,950	25-percent overhead
	$1,524,800	total

Costs to floodproof the 118 and 182 farmsteads in the 50-year and 100-year floodplains, respectively, were arrived at in a similar manner.

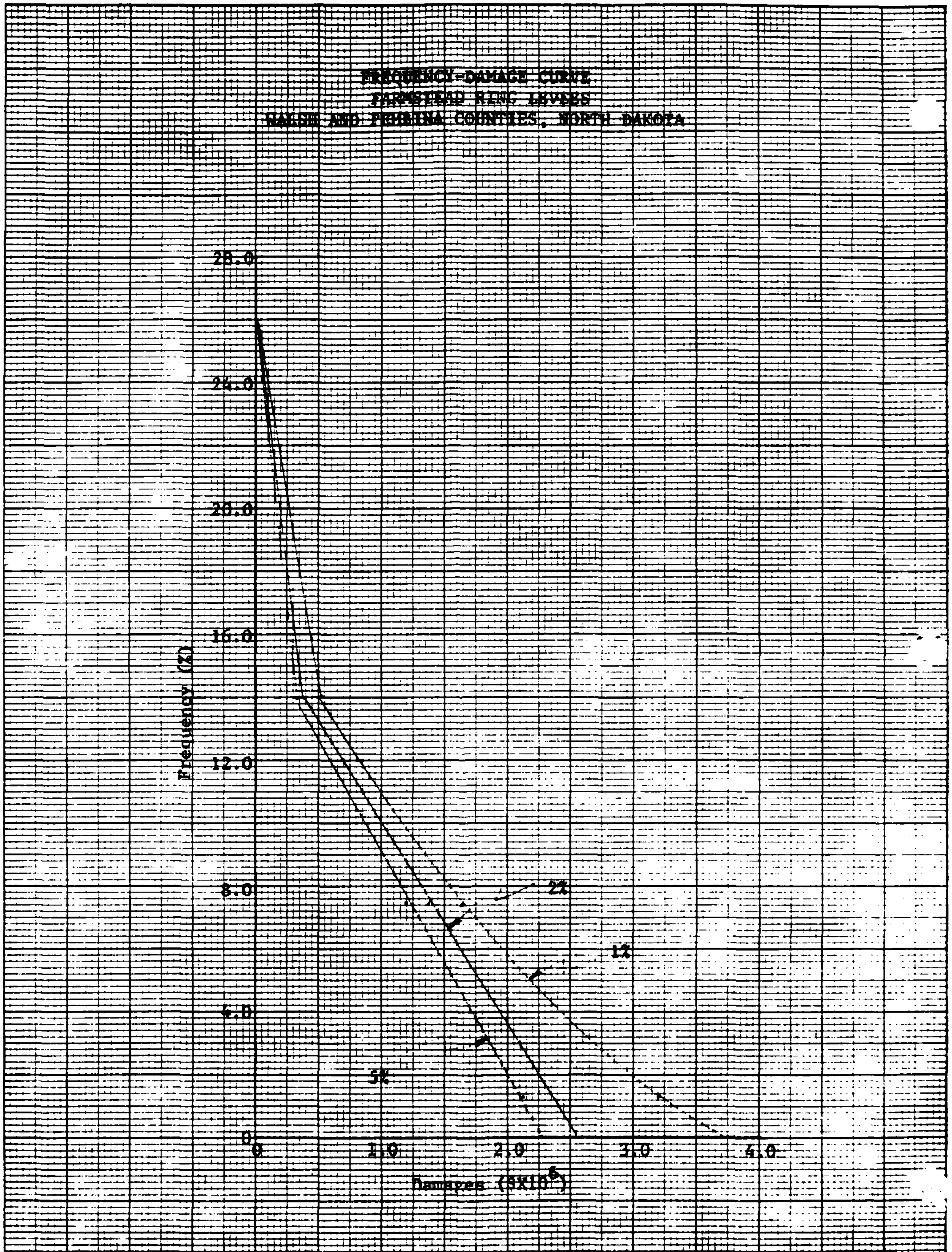
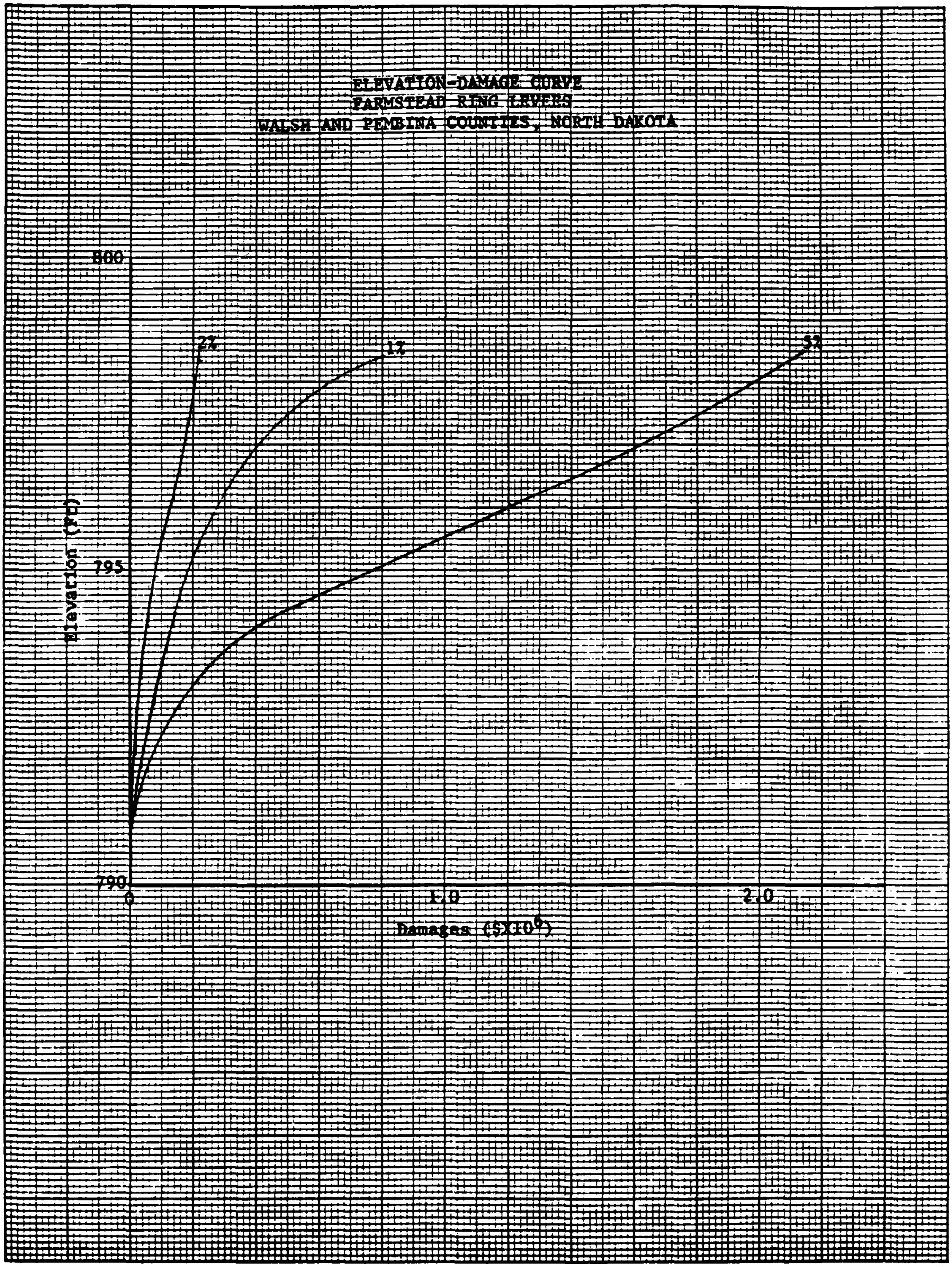

FREQUENCY-DAMAGE CURVE
FARMSTEAD RING LEVEES
WALSH AND PEMBINA COUNTIES, NORTH DAKOTA
28.0
24.0
20.0
16.0
12.0
8.0
4.0
0
Frequency (%)
0
1.0
2.0
3.0
4.0
Damages ($X10^6)
2%
1%
5%

FIGURE 1



ELEVATION-DAMAGE CURVE
FARMSTEAD RING LEVEES
WALSH AND PEMBINA COUNTIES, NORTH DAKOTA
800
795
790
Elevation (Ft)
2%
1%
5%
0
1.0
2.0
Damages ($X10^6)

FIGURE 2

APPENDIX C

TECHNICAL INFORMATION

SECTION 4

CULTURAL RESOURCES

SECTION 4
CULTURAL RESOURCES

During the fall of 1982, the St. Paul District, Corps of Engineers, contracted with the University of South Dakota Archaeology Laboratory to conduct a reconnaissance level cultural resources investigation of the Red River of the North farmstead ring levee project, Pembina and Walsh Counties, North Dakota. The investigation entailed conducting a literature and records search and a 15-percent, stratified, random sample survey of 314 farmsteads. The purpose of this investigation was to establish a predictive model for site locations that could be used during future study efforts.

For the literature and records search, records were examined at the North Dakota State Historical Society, Minnesota Historical Society, and Pembina and Walsh County Courthouses at Cavalier and Grafton, respectively. Libraries used include the North Dakota State Historical Society (Bismarck), Minnesota Historical Society (St. Paul), Carnegie Regional Library in Grafton, and I.D. Weeks Library on the Campus of the University of South Dakota (Vermillion). Other sources used include the Kittson County Enterprise in Hallock (Minnesota), Pembina State Museum and Park at Pembina, Pembina County Museum at Cavalier, Pembina County Historical Society, Walsh County Historical Society, Manitoba Museum of Man and Nature in Winnipeg (Manitoba, Canada), and U.S. General Land Office survey maps and records available at the North Dakota State Water Commission office. This literature and records search identified a number of previously recorded sites in the project area. None of these sites, however, will be impacted by the proposed project.

In addition to the literature and records search, 18 local informants were interviewed because of their extensive knowledge of the prehistory and history of the project area. Seven previously unrecorded sites were located in the project area based on information from these interviews.

The stratified, random sample of 314 farmsteads was made by dividing the project area into three major physiographic-vegetation subareas: (1) the Red River environs; (2) the Major Tributaries environs; and (3) the Flat Lands. Each of the 314 farmsteads was then assigned to one of these subareas and a 15-percent random sample of each subareas was made.

A total of 87 farmsteads are within the subarea designated as the Red River of the North. A random 15-percent sample of the 87 farmsteads yielded a sample size of 13. A total of 80 farmsteads are within the subarea designated as the Major Tributaries, with a 15-percent sample yielding 12 farmsteads. Finally, a total of 147 farmsteads are located within the subarea designated as the Flat Lands. A 15-percent random sample yielded 22 farmsteads to be intensively investigated. Therefore, a total of 47 farmsteads were were selected for field examination.

Field work consisted of spacing a team of of archeologists approximately 15 to 20 meters apart and traversing the lands adjacent to the farmsteads. Shovel tests were dug at 15-to 20-meter intervals in areas where vegetation cover was 75 percent or more. The field reconnaissance of the 47 farmsteads resulted in the recording of six sites. Two of these sites were located in the Red River environs subarea, four were located in the Major Tributaries environs subarea, and none were located in the Flat Lands subarea.

The following table shows the expected site frequencies for the study area based on the number of sites located.

Expected Site Frequencies[1]

	Red River	Tributaries	Flat Lands
Total farmsteads	87	80	147
15-percent	13	12	22
Sites actually recorded during 15-percent sample survey	2	4	0
Expected site numbers	13	26	-3
Percentage of farmsteads which may have sites	15	33	Probably less than 2

(1) This table includes the site frequencies based only on the 15-percent random sample. The sites located from informant interviews are not statistically valid and cannot be included in the predictive model.

This table shows that sites are most likely to be located at or near farmsteads that are situated within the Major Tributaries environs of the Red River. This does not mean that sites will not be located elsewhere but rather that it can be predicted that sites will be found at the highest percentage of farmsteads in this type of environment.

Surveys will be conducted at farmsteads, as needed, that will be impacted by the construction of ring levees. However, farmsteads will be prioritized on the basis of these survey results. Farmsteads in high probability areas will given first priority for manpower and resources.

APPENDIX C

TECHNICAL INFORMATION

SECTION 5

RECREATION

SECTION 5
RECREATION

TABLE OF CONTENTS

TABLES

INTRODUCTION

PURPOSE

This section identifies recreation potentials in a 140-mile area along the Red River of the North. The southern limit of this area is the northern limit of urbanization in Grand Forks, North Dakota, and East Grand Forks, Minnesota. The northern limit is the international border between the United States and Canada. The width of the study area coincides with the limit of the 100-year floodplain. In this section, recreational facilities currently available in the study area are first presented and then areas with potential for development are identified.

METHODOLOGY

The study relies on reconnaissance-type methods. Previous studies[1] revealed the names of many of the existing recreation areas. Aerial photographs at a scale of 1:24,000 were examined to locate areas for potential development. These areas were identified on the basis of tree cover, proximity to water, and convenient access. Twenty-two potential sites were identified in this manner. A field reconnaissance narrowed this list to ten sites. Reasons for rejection of some sites included:

- o Proximity to one or more inhabited residences.
- o Inconvenient or poor quality access roads.
- o Low-lying areas and steep riverbanks.
- o Insufficient width to permit development.

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[1] U.S. Army Corps of Engineers, Recreation Sites Under 15 Acres, Red River of the North Basin, 1981.

U.S. Army Corps of Engineers, Red River of the North Reconnaissance Report, Main Stem Subbasin, Final Report, December 1980.

Data collected from existing studies and photographs, as verified in the field, were plotted on the base maps. These maps inventory existing recreation opportunities and present sites with the potential for development (1:24,000 acale maps).

School athletic fields have been eliminated from consideration in this report because they serve a very different function from outdoor recreation areas. Their attraction is limited to community residents and to school-aged children. Their appeal is not widespread.

EXISTING RECREATION AREAS

Existing outdoor recreation facilities are limited within the study area. Presently, all but one of the sites are located within the municipalities scattered along the river. The ones that do exist are well maintained and appear to be used regularly for a variety of activities. As stated before, school playgrounds have not been considered in this investigation. Table 1 presents an inventory of existing recreation areas.

TABLE 1 - Existing Recreation Areas In North Dakota

Name	City/County	Activities/Facilities
Drayton Municipal Park	Drayton/Pembina	Camping
		Picnicking
		Picnic shelters (3)
		Picnic tables
		Play area
		Charcoal grills
		Swimming pool
		Tennis courts (2)
		Rest rooms
		Ballpark

Drayton Municipal Park Course	Drayton/Pembina	Golf (9 holes)
Pembina Masonic Historic Park	Pembina/Pembina	None
Pembina Historic Site	Pembina/Pembina	Picnicking Charcoal grills Play area Ball park
Red River Access	Pembina/Pembina	Boat ramp Fishing
Walhalla Golf Course	Pembina/Pembina	Golf (9 holes)
Red River Access (N.D. WMA)	Drayton/Pembina	Boat ramp Fishing

Camping facilities are available only at Drayton Municipal Park. Other than this location, the nearest camping is located at the Oslo Municipal Park south of Grand Forks, North Dakota, and in Grafton, 10 miles from Interstate Highway 29. The latter site is well out of the 100-year floodplain.

Picnic facilities are somewhat more numerous. Drayton Municipal Park and Pembina Historic Site both provide tables and shelters. Along the entire 140-mile stretch of river, only two boat access points exist. Both are in Pembina County.

Opportunities for hunting, birdwatching, fishing, sightseeing, and nature study can be found at locations independent of designated recreation areas. The entire study area, therefore, is a recreation resource to some extent.

RECREATION PARTICIPATION

Participation estimates and projections (measured in total days) for the ten most popular activities in Region 4 (North Dakota) are presented in table 2. Region 4 is composed of four counties: Pembina, Walsh, Nelson, Grand Forks.

TABLE 2 - Total Days of Participation In North Dakota Region 4

Activity	1978	1980	1985	1990	1995
Bicycling	32.6	34.9	38.7	42.7	43.8
Ice skating	18.7	20.5	17.5	17.3	15.3
Outdoor pool swimming	16.6	15.5	16.9	17.0	16.6
Snowmobiling	14.3	14.7	15.1	16.0	16.0
Golf	14.2	16.3	19.3	21.6	22.1
Sledding	10.9	19.7	10.4	11.6	10.8
Jogging	10.7	10.2	12.3	12.9	12.9
Picnicking	9.8	11.3	13.7	15.2	16.2
Fishing	9.7	10.5	11.4	12.0	12.6
Beach swimming	8.0	10.9	14.4	16.7	17.7

Source: North Dakota SCORP, 1980, pg. 4-19.

In Region 4, the most popular activity by far is bicycling. The popularity of bicycling is expected to increase through 1995, and bicycling will have over twice the participation of any other activity[(1)]. Golf, jogging, picnicking, and beach swimming are also expected to show increases in popularity. Ice skating is the only activity of the 10 most popular activities in the region to show a projected decrease in participation. Outdoor pool swimming, snowmobiling, and sledding will receive fairly constant participation through 1995.

(1) North Dakota SCORP, 1980, pg. 4-19.

The North Dakota SCORP trends indicate a general increase in the already popular activities. Recommendations provided in the North Dakota SCORP are on a statewide level. Trail facilities (particularly for bicycling, snowmobiling, and jogging), wintertime facilities, and parks and playgrounds are the top facility needs identifed.

Caution is necessary when interpreting participation data presented earlier. Analysis of projected participation for the study areas was based on regional data. The two regions used in the analysis include much more area than the study area of this project. Applying regional level data to a smaller area assumes homogeneity of recreation needs throughout the region. This is seldom the case due to local population concentrations, popularity of certain activities, and the supply of facilities. Sensitivity to these intra-regional variations is important to properly provide for recreation needs of the people.

POTENTIAL RECREATION AREAS

These recreations areas are:

1. Pembina River. Located approximately 6 miles west of the I-29 exit at Pembina, North Dakota. The site is somewhat narrow with approximately 11 acres available for development. An access road would be needed for approximately 1/8 mile. Camping, picnicking, and a small play area could be accommodated. Access is along the paved Highway 55.

2. North Dakota Highway 5 and Minnesota 175 bridge crossing. The site is approximately 3 miles east of I-29. Both banks have potential for development, but the left bank (North Dakota side) offers the best area. The site is approximately 9 acres of large deciduous trees with low undergrowth. The site could be developed for

camping (both trailer and tent), picnicking, boat access, fishing, and a play area. Showers could be provided, but floodproofing or construction of a permanent structure within the floodway present severe constraints.

3. Bridge crossing along Highway 66 in North Dakota and Highway 11 in Minnesota. Paved access roads and proximity to Drayton (1.5 miles) make this site attractive. Approximately 2 miles north of the site is a low dam which attracts fishermen. The optimum site is north of the highway in North Dakota. Camping (both trailer and tent), picnicking, boat access, fishing, and a play area are recommended. Showers could be provided, but floodway delineation and floodproofing offer significant constraints. Approximately 23 acres are available.

4. Bridge crossing of North Kakota Highway 17 and Minnesota Highway 317. Again, the bridge crossing provides excellent all-weather access. The optimum site is again north of the highway in North Dakota (approximately 11 acres), but the area south of the highway on the Minnesota side offers possibilities. Because of the access, camping (trailers and tents), picnicking, fishing and boat access, and a play area are recommended. The site is less desirable than 3 above, only because no towns are nearby.

5. This location is actually two relatively small pieces of property on either side of the river near Oslo. The location offers an opportunity to develop camping facilities (trailers and tent) now absent at Oslo Municipal Park. The Minnesota side (4 acres) is largely open with some trees to the north and is highly suited for camping. The North Dakota side is smaller by comparison (3 acres) and may accommodate a small camping area. A boat ramp could be located on either bank. The proximity of Oslo offers security and services.

6. This site is a relatively narrow strip of property (approximately 1 acre) along the North Dakota bank about 2 miles south of Oslo. boat access could be provided even though the banks are somewhat steep at the site. Fishing would likely become important at the site. Several picnic tables could be provided but space is not sufficient for a designated recreation area (shelters, grills, etc.).

APPENDIX C

TECHNICAL INFORMATION

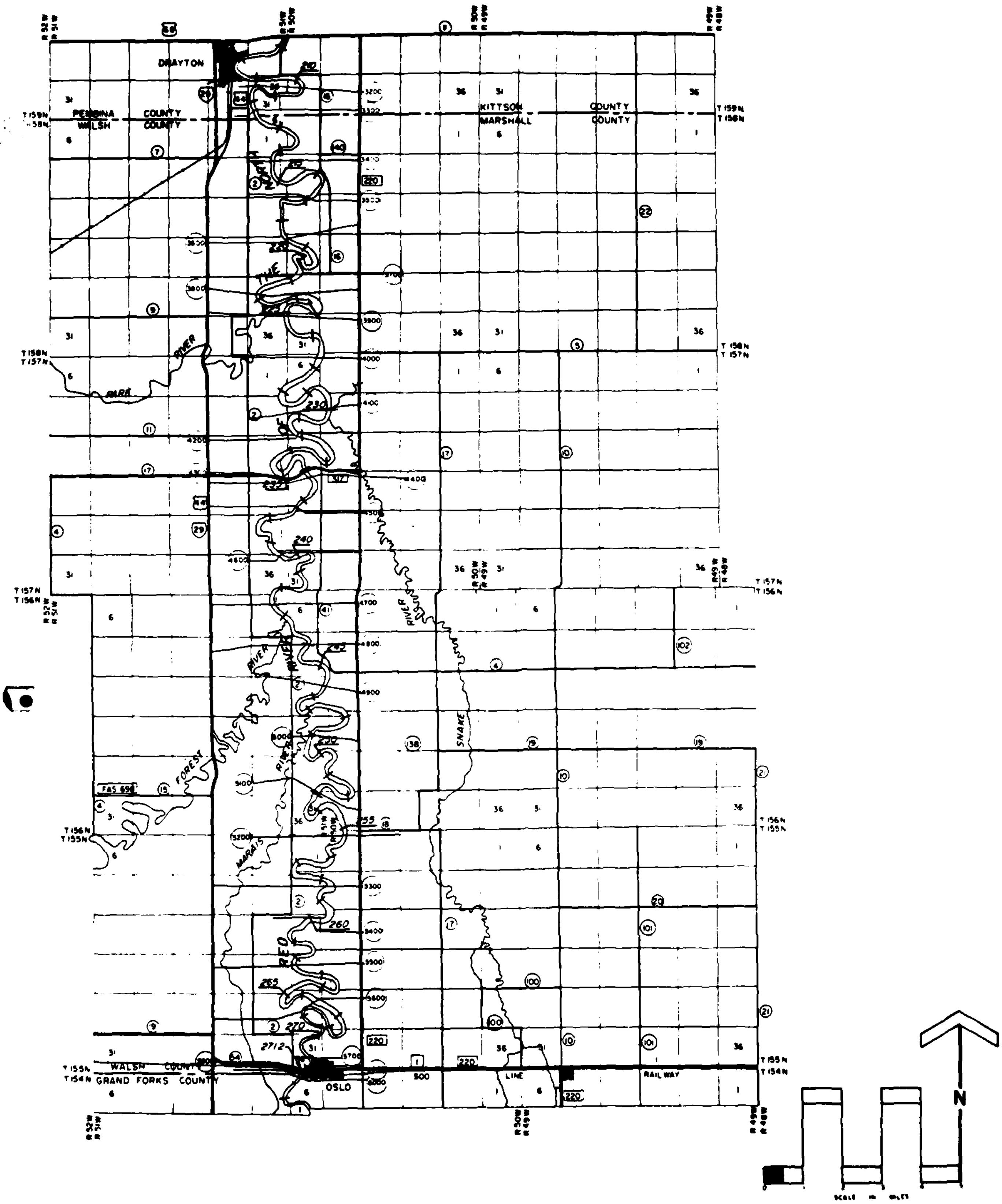
SECTION 6

CROSS SECTIONS

SECTION 6

CROSS SECTIONS

TABLE OF CONTENTS



RED RIVER MAIN STEM

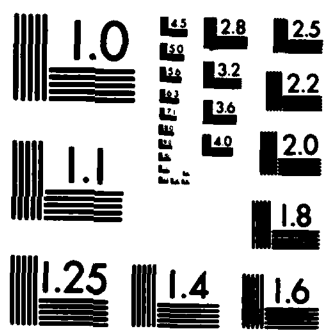
RIVER MILE 206 - RIVER MILE 271

DRAYTON - OSLO

1981

AD-A146 629 RED RIVER OF THE NORTH WALSH AND PEMBINA COUNTRIES NORTH DAKOTA FARMSTEAD RING LEVEES(U) CORPS OF ENGINEERS ST PAUL MN ST PAUL DISTRICT DEC 83 3/4

UNCLASSIFIED F/G 13/2 NL



'OPY RESOLUTION TEST CHART

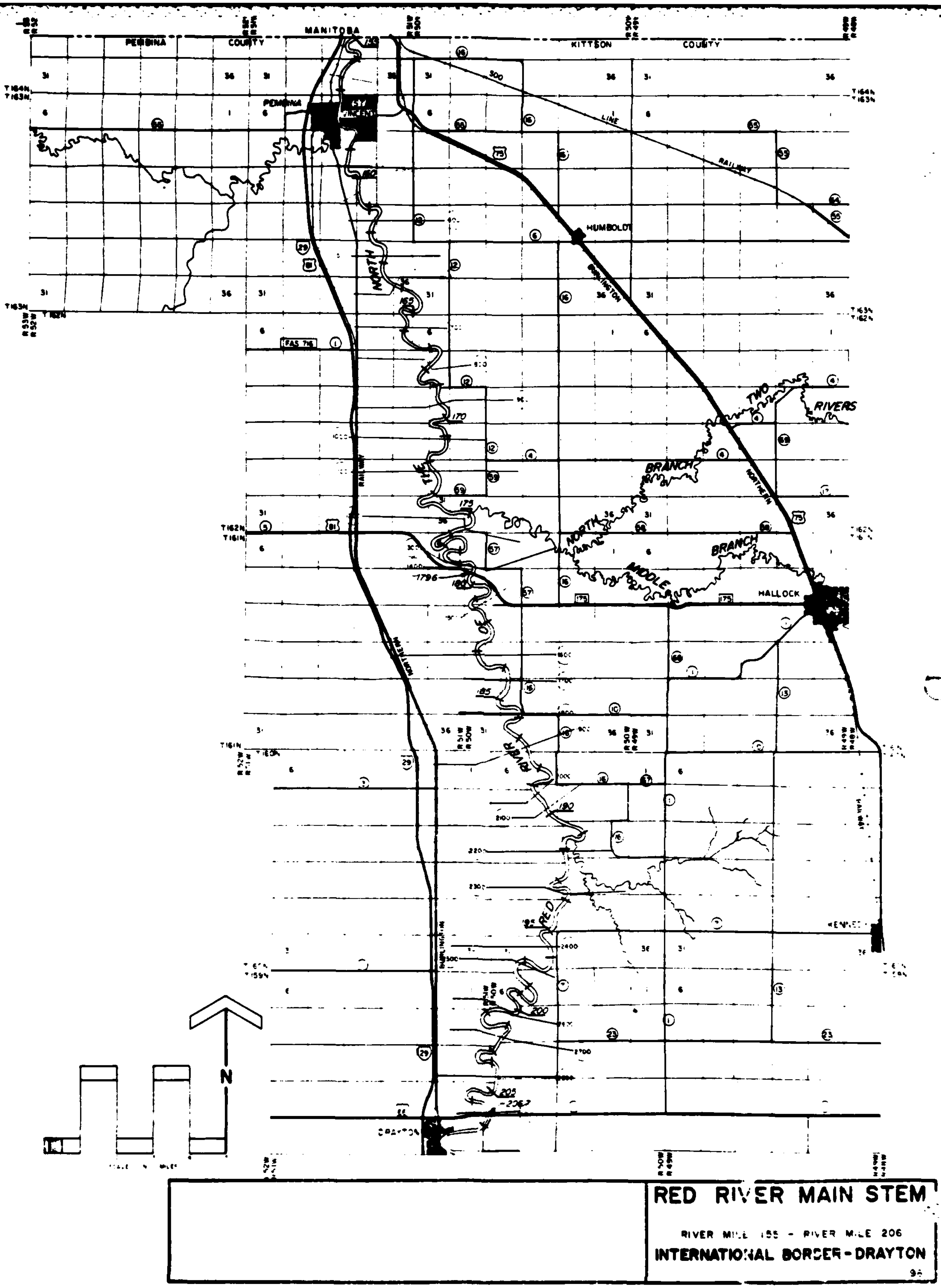

MANITOBA
PEMBINA
COUNTY
KITTSON
COUNTY
PEMBINA
ST. VINCENT
HUMBOLDT
HALLOCK
DRAYTON
NORTH
TWO
RIVERS
BRANCH
MIDDLE
RED
RIVER
OF
THE
N
RED RIVER MAIN STEM
RIVER MILE 155 - RIVER MILE 206
INTERNATIONAL BORDER - DRAYTON

TABLE 8

TABULATION OF CROSS-SECTION GEOMETRIC DATA AND RIVER MILEAGE FOR THE RED RIVER OF THE NORTH MAIN STEM FROM EMERSON TO GRAND FORKS, ND.

CROSS SECTION NUMBER	RIVER MILE	CHANNEL LENGTH (FEET)	THALWEG ELEV	LEFT BANK ELEV	LEFT BANK STA	RIGHT BANK ELEV	RIGHT BANK STA	CHANNEL TOPWID (FEET)	SECTION TOPWID-NATURAL
0	154.30	0.0	736.10	775.00	50000.0	775.00	50375.0	375.0	11365.0
.10	154.49	1000.0	736.00	775.00	50000.0	775.00	50570.0	570.0	11000.0
.20	154.58	475.0	736.50	793.00	50000.0	794.00	50500.0	500.0	25000.0
.21	154.59	50.0	736.50	793.00	50000.0	794.00	50500.0	500.0	25000.0
.30	154.63	225.0	739.00	775.00	50000.0	775.00	50530.0	530.0	20000.0
.40	154.72	450.0	740.00	794.50	50000.0	793.00	50736.0	736.0	25700.0
.50	154.73	50.0	740.00	794.50	50000.0	793.00	50736.0	736.0	25700.0
.51	154.74	50.0	740.00	794.50	50000.0	793.00	50736.0	736.0	25700.0
.52	154.75	50.0	741.00	775.00	50000.0	775.00	50460.0	460.0	11000.0
.60	154.99	1300.0	738.00	775.00	50000.0	775.00	50532.0	532.0	12000.0
100	156.78	9450.0	738.21	771.70	50000.0	779.81	50420.0	420.0	12700.0
10	157.16	2000.0	739.80	775.00	50000.0	775.90	50439.0	439.0	13300.0
9	157.49	1750.0	739.40	775.00	50000.0	775.80	50391.0	391.0	13950.0
8	157.64	800.0	739.60	762.00	50000.0	763.40	50364.0	364.0	14600.0
7	157.79	800.0	741.60	763.10	50000.0	765.50	50352.0	352.0	13800.0
6	157.97	950.0	740.10	763.10	50000.0	768.70	50385.0	385.0	14950.0
5.10	158.03	300.0	740.10	765.00	50000.0	777.40	50521.0	521.0	13400.0
5	158.03	1.0	740.10	765.00	50000.0	777.40	50521.0	521.0	13400.0
4.10	158.11	400.0	736.00	794.10	50000.0	797.40	50768.0	768.0	16000.0
4.20	158.11	22.0	736.00	794.10	50000.0	797.40	50768.0	768.0	16000.0
4	158.19	400.0	739.10	769.10	50000.0	780.00	50500.0	500.0	15600.0
3	158.36	900.0	738.00	760.00	50000.0	775.00	50500.0	500.0	15900.0
2	158.60	1300.0	737.20	775.00	50000.0	775.00	50500.0	500.0	14700.0
1	159.17	3000.0	737.92	767.02	50000.0	766.32	50350.0	350.0	14200.0
200	159.46	1530.0	739.89	781.99	50000.0	783.29	50730.0	730.0	15800.0
300	160.46	5290.0	739.96	786.36	50000.0	779.99	50670.0	670.0	25580.0
400	161.69	6492.0	734.20	786.26	50000.0	779.77	50830.0	830.0	27500.0
500	162.87	6202.0	735.60	783.59	50000.0	779.35	50850.0	850.0	23700.0
600	163.71	4457.0	743.06	775.01	50000.0	780.35	50615.0	615.0	22000.0
700	165.99	12016.0	742.63	781.95	50000.0	777.93	50662.0	662.0	20000.0
800	167.73	9206.0	741.00	785.10	50000.0	779.10	50760.0	760.0	37070.0
900	169.49	9303.0	741.30	777.90	50000.0	787.60	50690.0	690.0	23850.0
1000	171.05	8237.0	741.70	782.90	50000.0	784.40	51070.0	1070.0	34500.0
1100	172.34	6783.0	739.70	780.60	50000.0	785.90	50800.0	800.0	42270.0
1200	175.46	16474.0	746.10	783.40	50000.0	776.00	50431.0	431.0	39390.0
1300	178.44	21028.0	742.29	781.20	50000.0	778.89	50755.0	755.0	38590.0
1310	178.54	520.0	741.30	800.60	50000.0	798.60	51310.0	1310.0	42800.0
1320	178.56	40.0	741.30	800.60	50000.0	798.60	51310.0	1310.0	42800.0
1400	178.63	420.0	739.74	784.13	50000.0	776.34	50540.0	540.0	41400.0
1500	181.63	10606.0	738.35	782.49	50000.0	788.04	50923.0	923.0	42000.0
1600	183.22	8348.0	740.00	788.20	50000.0	782.90	50875.0	875.0	39345.0
1700	184.48	6678.0	745.99	786.52	50000.0	783.39	50545.0	545.0	38300.0
1800	186.08	8446.0	739.84	779.82	50000.0	786.24	50540.0	540.0	34500.0

TABLE 8

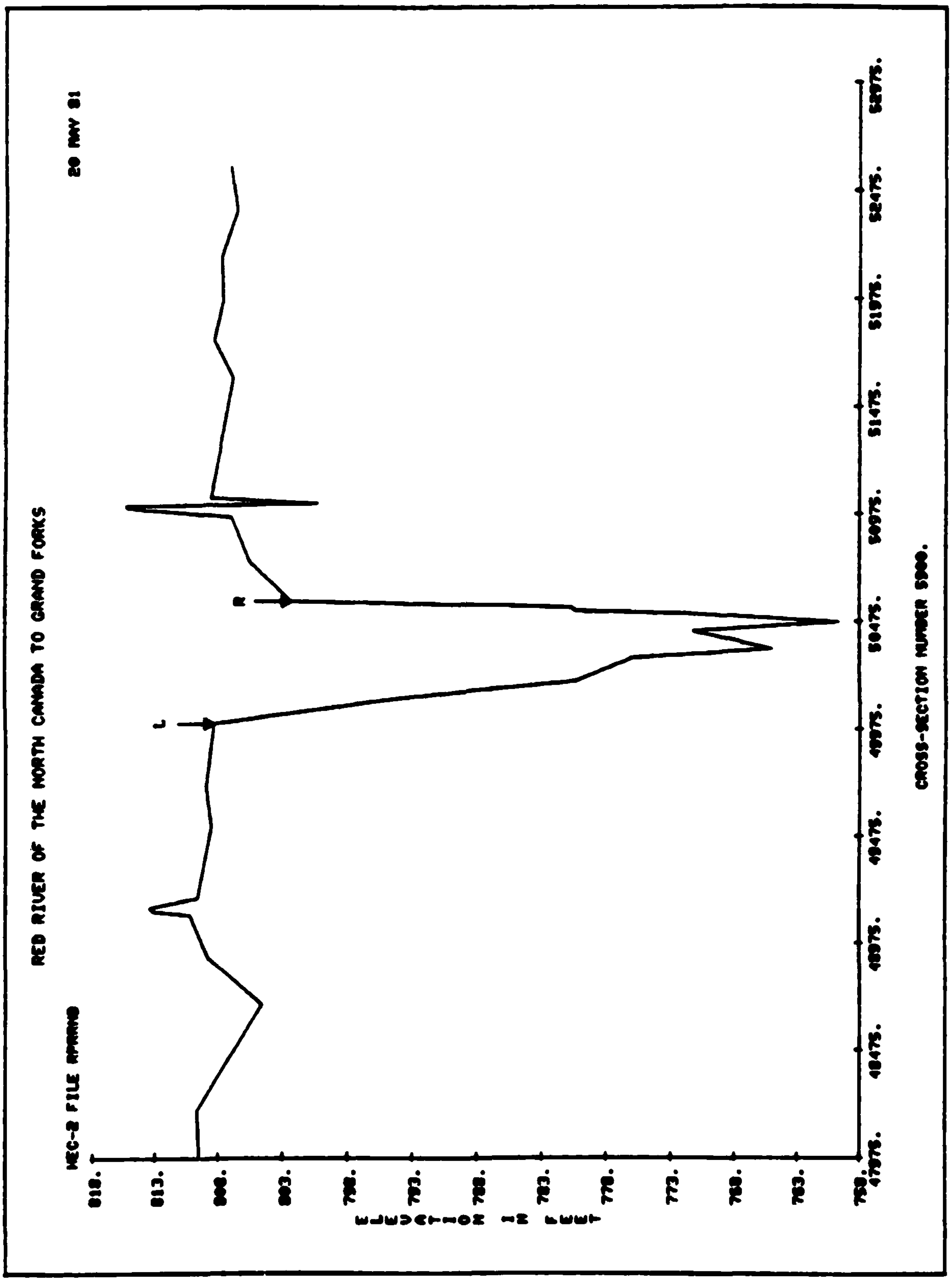
TABULATION OF CROSS-SECTION GEOMETRIC DATA AND RIVER MILEAGE FOR THE RED RIVER OF THE NORTH MAIN STEM FROM EMERSON TO GRAND FORKS, ND.

CROSS SECTION NUMBER	RIVER MILE	CHANNEL LENGTH (FEET)	THALWEG ELEV	LEFT BANK ELEV	LEFT BANK STA	RIGHT BANK ELEV	RIGHT BANK STA	CHANNEL TOPWID (FEET)	SECTION TOPWID-NATURAL
1900	187.61	8053.0	747.20	786.10	50000.0	788.90	50867.0	867.0	30000.0
2000	189.52	10115.0	747.66	786.09	50000.0	787.59	50672.0	672.0	37800.0
2100	190.04	2750.0	743.34	780.50	50000.0	783.79	50650.0	650.0	33200.0
2200	192.27	11784.0	750.60	786.40	50000.0	793.80	50754.0	754.0	34900.0
2300	194.04	9329.0	748.80	788.90	50000.0	781.70	50490.0	490.0	30060.0
2400	195.92	9919.0	749.00	784.80	50000.0	789.70	50938.0	938.0	31420.0
2500	197.52	8446.0	748.50	789.60	50000.0	782.20	51042.0	1042.0	34750.0
2600	200.20	14141.0	751.60	784.10	50000.0	785.70	51144.0	1144.0	21278.0
2700	202.71	13258.0	752.90	785.61	50000.0	786.10	51050.0	1050.0	20570.0
2710	203.50	4200.0	753.50	775.00	50000.0	780.00	50900.0	900.0	18000.0
2720	203.51	20.0	763.00	775.00	50000.0	780.00	50900.0	900.0	18000.0
2730	203.51	10.0	763.00	775.00	50000.0	780.00	50900.0	900.0	18000.0
2740	203.51	20.0	753.90	775.00	50000.0	780.00	50900.0	900.0	18000.0
2800	204.64	5963.0	755.10	778.83	50000.0	789.40	50841.0	841.0	17773.0
2900	206.56	10115.0	752.95	786.91	50000.0	799.27	51227.0	1227.0	24110.0
2905	206.70	0.0	752.95	786.91	50000.0	799.27	51227.0	1227.0	24110.0
2910	206.70	5.0	754.70	799.30	50000.0	800.60	51057.0	1057.0	23027.0
2920	206.71	30.0	754.70	799.30	50000.0	800.60	51057.0	1057.0	23027.0
2930	206.71	5.0	756.09	781.59	50000.0	791.73	50781.0	781.0	24580.0
3000	206.77	343.0	756.09	781.59	50000.0	791.73	50781.0	781.0	24580.0
3100	208.21	7615.0	748.93	775.56	50000.0	781.92	50800.0	800.0	17310.0
3200	210.13	10119.0	755.40	779.90	50000.0	777.50	50632.0	632.0	17719.0
3300	212.12	10504.0	756.39	785.17	50000.0	783.89	50448.0	448.0	18560.0
3400	214.37	11855.0	757.21	780.43	50000.0	781.98	50541.0	541.0	24320.0
3500	216.76	12625.0	755.33	788.84	50000.0	794.30	50690.0	690.0	29820.0
3600	218.53	9350.0	754.40	790.90	50000.0	791.30	50430.0	430.0	28200.0
3700	220.72	11568.0	757.56	781.02	50000.0	786.57	50452.0	452.0	20950.0
3800	221.91	6264.0	755.72	796.33	50000.0	782.81	50771.0	771.0	26630.0
3900	225.01	16383.0	755.30	790.70	50000.0	790.60	51181.0	1181.0	26624.0
4000	226.72	9059.0	757.80	791.30	50000.0	791.20	50743.0	743.0	31800.0
4100	229.86	16576.0	756.40	793.30	50000.0	793.90	50763.0	763.0	36575.0
4200	231.76	10023.0	757.34	793.27	50000.0	794.64	50505.0	505.0	37200.0
4300	235.96	22166.0	758.80	796.20	50000.0	793.80	51112.0	1112.0	37398.0
4310	236.07	600.0	759.20	804.20	50000.0	804.30	50410.0	410.0	35991.0
4320	236.08	26.0	759.20	804.20	50000.0	804.30	50410.0	410.0	35991.0
4400	236.16	433.0	759.10	793.80	50000.0	796.50	50850.0	850.0	36323.0
4500	237.18	5382.0	759.10	794.70	50000.0	793.80	50425.0	425.0	38207.0
4600	239.44	11926.0	762.07	797.25	50000.0	798.58	51026.0	1026.0	38800.0
4700	242.46	15953.0	757.83	796.26	50000.0	794.80	51100.0	1100.0	24250.0
4800	243.88	7495.0	762.40	797.30	50000.0	796.40	50478.0	478.0	25330.0
4900	245.46	8362.0	765.20	799.60	50000.0	799.50	50890.0	890.0	30035.0
4922	247.17	9021.0	762.80	795.90	50000.0	791.70	50346.0	346.0	30035.0
5000	248.94	9334.0	764.49	800.67	50000.0	798.05	50986.0	986.0	32590.0

TABLE 8

TABULATION OF CROSS-SECTION GEOMETRIC DATA AND RIVER MILEAGE FOR THE RED RIVER OF THE NORTH MAIN STEM FROM EMERSON TO GRAND FORKS, ND.

CROSS SECTION NUMBER	RIVER MILE	CHANNEL LENGTH (FEET)	THALWEG ELEV	LEFT BANK ELEV	LEFT BANK STA	RIGHT BANK ELEV	RIGHT BANK STA	CHANNEL TOPWID (FEET)	SECTION TOPWID-NATURAL
5100	252.76	20181.0	762.40	801.50	50000.0	804.20	50913.0	913.0	28760.0
5200	254.91	11340.0	765.50	800.70	50000.0	803.40	50692.0	692.0	28200.0
5300	258.22	17491.0	768.20	798.10	50000.0	801.60	51002.0	1002.0	28792.0
5400	259.81	8362.0	760.92	805.42	50000.0	793.72	50339.0	339.0	30139.0
5500	262.06	11916.0	768.00	803.10	50000.0	797.20	50586.0	586.0	27479.0
5600	266.19	21816.0	767.40	800.70	50000.0	799.40	50567.0	567.0	29191.0
5650	269.69	18443.0	770.30	801.36	50000.0	808.16	50674.0	674.0	32491.0
5670	270.20	2706.0	770.30	801.50	50000.0	808.30	50674.0	674.0	30936.0
5700	270.74	2876.0	768.80	794.60	50000.0	794.50	50569.0	569.0	30936.0
5800	271.18	2307.0	759.70	805.10	50000.0	803.40	50611.0	611.0	31389.0
5805	271.20	115.0	759.90	805.30	50000.0	803.60	50611.0	611.0	31389.0
5810	271.20	5.0	762.57	817.27	50000.0	816.67	50792.0	792.0	29933.0
5820	271.21	33.0	762.57	817.27	50000.0	816.67	50792.0	792.0	29933.0
5900	271.23	100.0	759.50	808.30	50000.0	802.20	50570.0	570.0	27775.0
5910	271.24	75.0	768.40	818.89	50000.0	818.76	50581.0	581.0	33380.0
5920	271.25	48.0	768.40	818.89	50000.0	818.76	50581.0	581.0	33380.0
5930	271.26	50.0	759.50	808.30	50000.0	802.20	50570.0	570.0	27775.0
6000	271.28	110.0	765.00	806.70	50000.0	804.40	50622.0	622.0	22200.0
6100	271.94	3506.0	772.50	802.30	50000.0	806.10	50587.0	587.0	20800.0
6200	272.87	4871.0	772.90	805.60	50000.0	810.10	50635.0	635.0	19500.0
6300	275.82	15586.0	770.40	805.50	50000.0	805.30	50686.0	686.0	24500.0
6305	276.25	2259.0	770.40	805.50	50000.0	805.40	50686.0	686.0	24500.0
6310	276.26	50.0	770.40	805.50	50000.0	805.30	50686.0	686.0	21100.0
6315	276.26	50.0	770.40	805.60	50000.0	805.70	50686.0	686.0	24500.0
6400	277.11	4460.0	771.40	804.80	50000.0	803.10	50642.0	642.0	19460.0
6500	279.80	14223.0	768.70	806.90	50000.0	808.20	50413.0	413.0	19500.0
6600	280.63	4384.0	773.70	805.90	50000.0	799.40	50328.0	328.0	16254.0
6700	281.74	5839.0	768.40	807.90	50000.0	809.90	50356.0	356.0	16010.0
6705	282.24	2661.0	768.40	807.90	50000.0	809.90	50356.0	356.0	16010.0
6710	282.25	50.0	768.40	807.80	50000.0	813.60	50356.0	356.0	15450.0
6715	282.26	50.0	768.40	807.90	50000.0	809.90	50356.0	356.0	21210.0
6800	283.16	4739.0	770.20	809.50	50000.0	805.40	50788.0	788.0	19258.0
6900	284.65	7891.0	774.80	811.60	50000.0	816.50	50368.0	368.0	18889.0
7000	285.76	5846.0	772.40	813.90	50000.0	803.50	50420.0	420.0	18900.0
7100	286.59	4384.0	777.10	817.10	50000.0	817.70	50788.0	788.0	15758.0
7200	287.83	6527.0	769.50	817.40	50000.0	821.00	50497.0	497.0	13450.0
7300	288.92	5747.0	772.00	808.10	50000.0	804.90	50414.0	414.0	6412.0
7400	290.80	9938.0	773.00	806.20	50000.0	810.80	50500.0	500.0	7880.0
7500	292.09	6820.0	777.00	819.00	50000.0	821.30	50730.0	730.0	4308.0
7600	292.92	4384.0	770.40	818.30	50000.0	810.90	50630.0	630.0	3200.0
7700	294.29	7210.0	767.62	812.85	50000.0	814.07	50555.0	555.0	5510.0
7790	295.70	7470.0	773.15	826.86	50000.0	816.72	50960.0	960.0	4488.0
7800	296.00	1584.0	774.20	827.91	50000.0	817.77	50960.0	960.0	4488.0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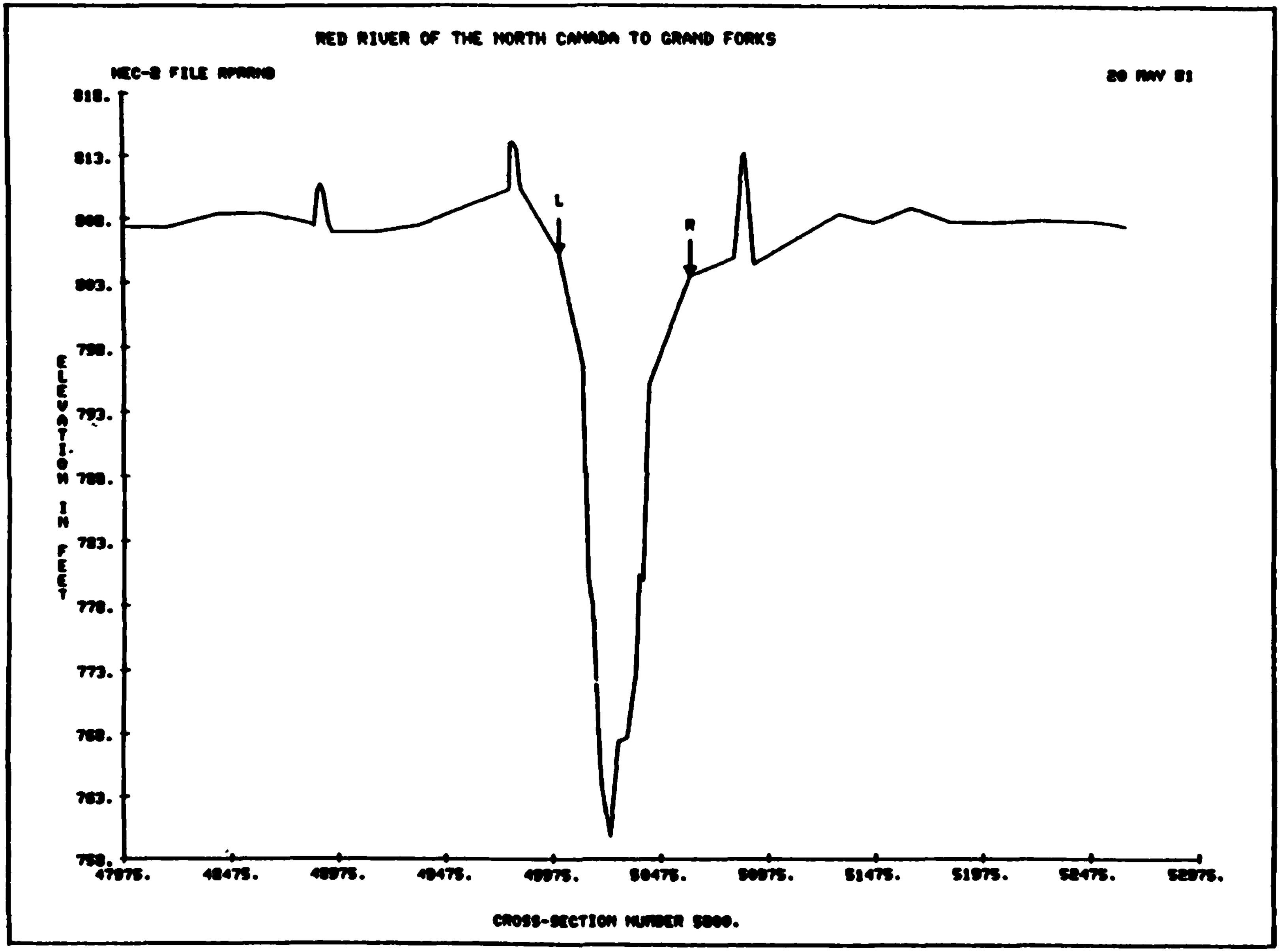
20 MAY 81
ELEVATION IN FEET
CROSS-SECTION NUMBER 5000.


RED RIVER OF THE NORTH CANADA TO GRAND FORKS
HEC-2 FILE APRRNO
20 MAY 81
ELEVATION IN FEET
818.
813.
808.
803.
798.
793.
788.
783.
778.
773.
768.
763.
758.
47975.
48475.
48975.
49475.
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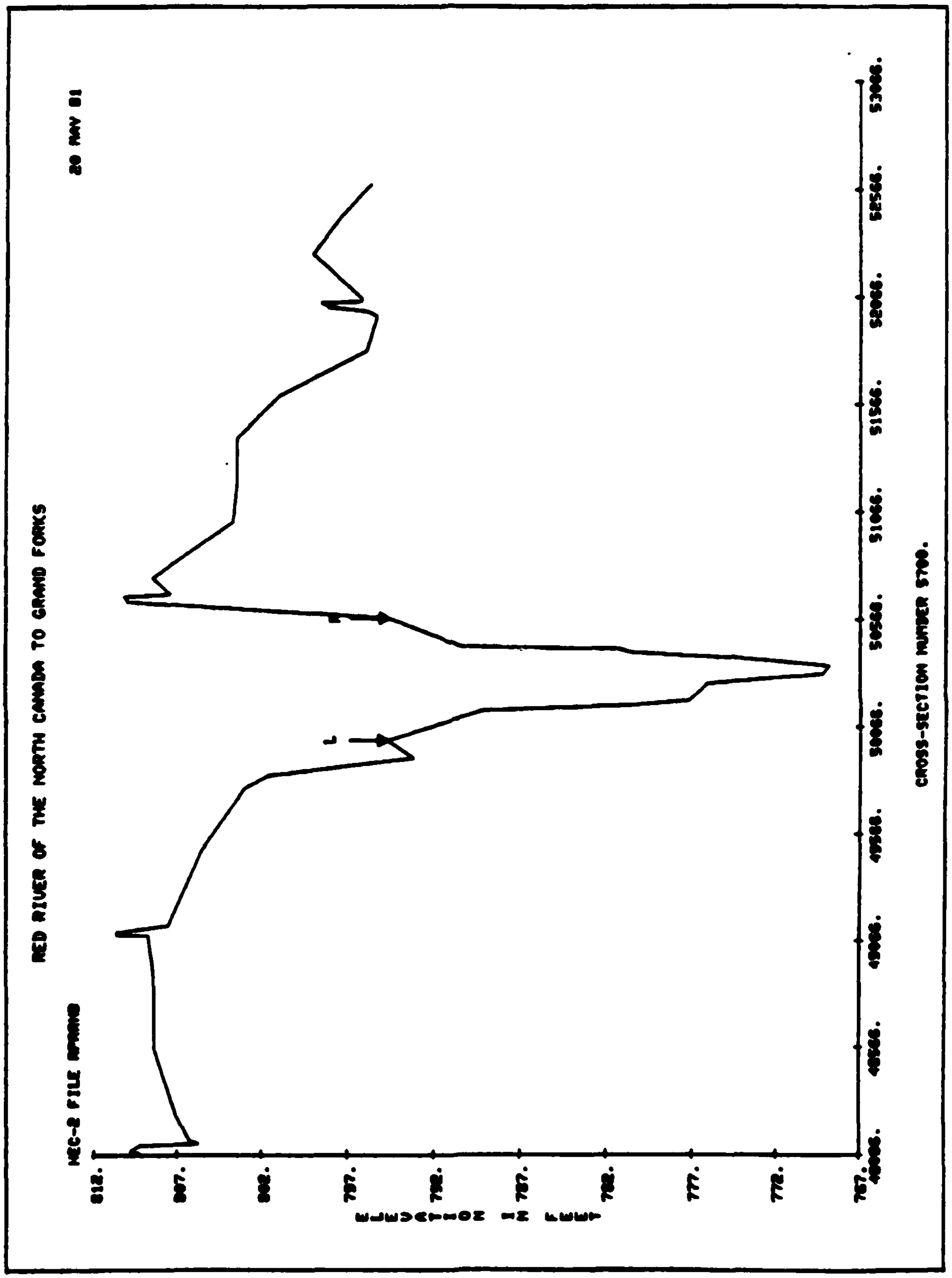
L
R
CROSS-SECTION NUMBER 5000.


HEC-2 FILE
RED RIVER OF THE NORTH CANADA TO GRAND FORKS
20 MAY 81
ELEVATION IN FEET
812.
807.
802.
797.
792.
787.
782.
777.
772.
767.
48000.
48500.
49000.
49500.
50000.
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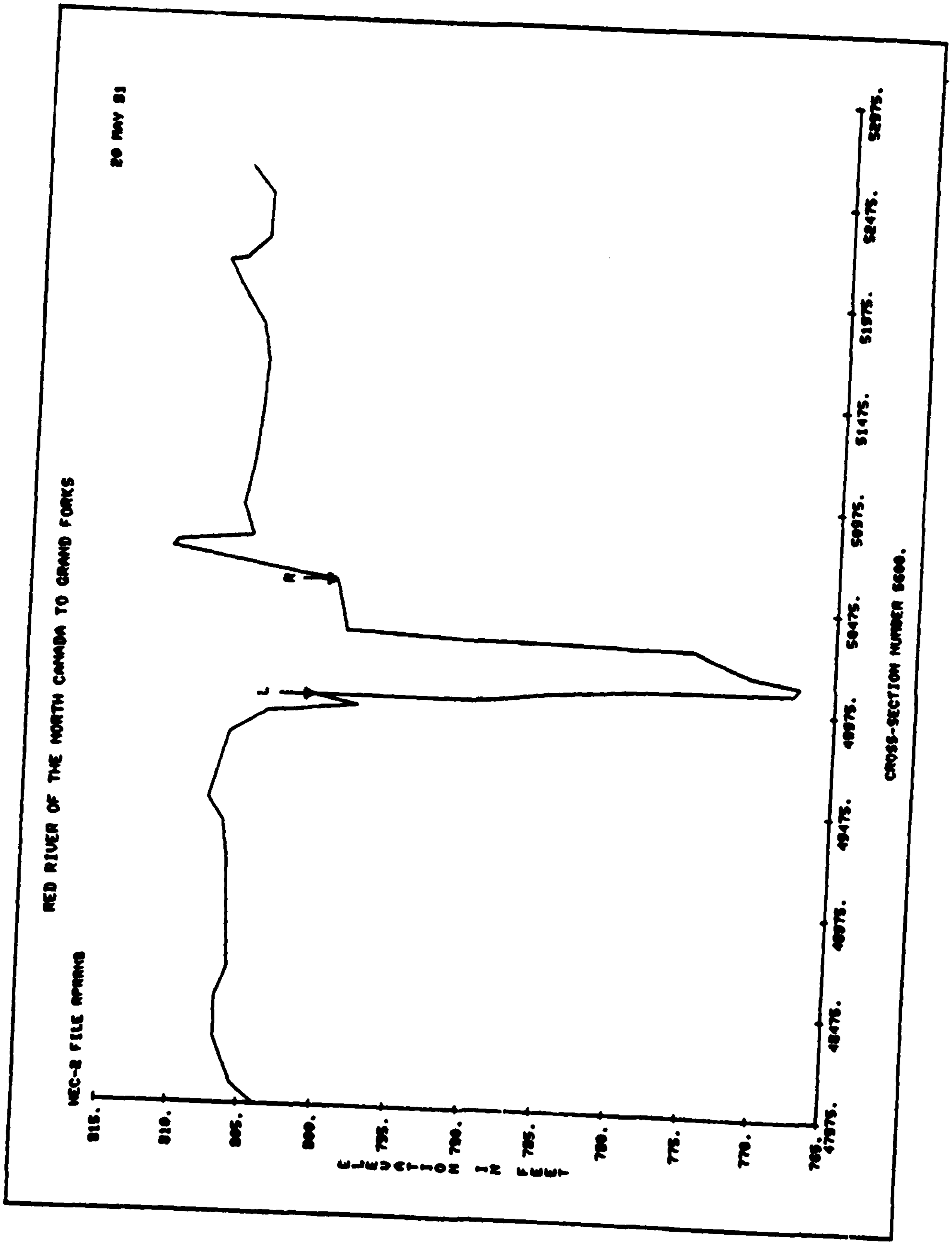
51000.
51500.
52000.
52500.
53000.
L
R
CROSS-SECTION NUMBER 5700.


RED RIVER OF THE NORTH CANADA TO GRAND FORKS
20 MAY 81
HEC-2 FILE
ELEVATION IN FEET
CROSS-SECTION NUMBER 5600.
815.
810.
805.
800.
795.
790.
785.
780.
775.
770.
765.
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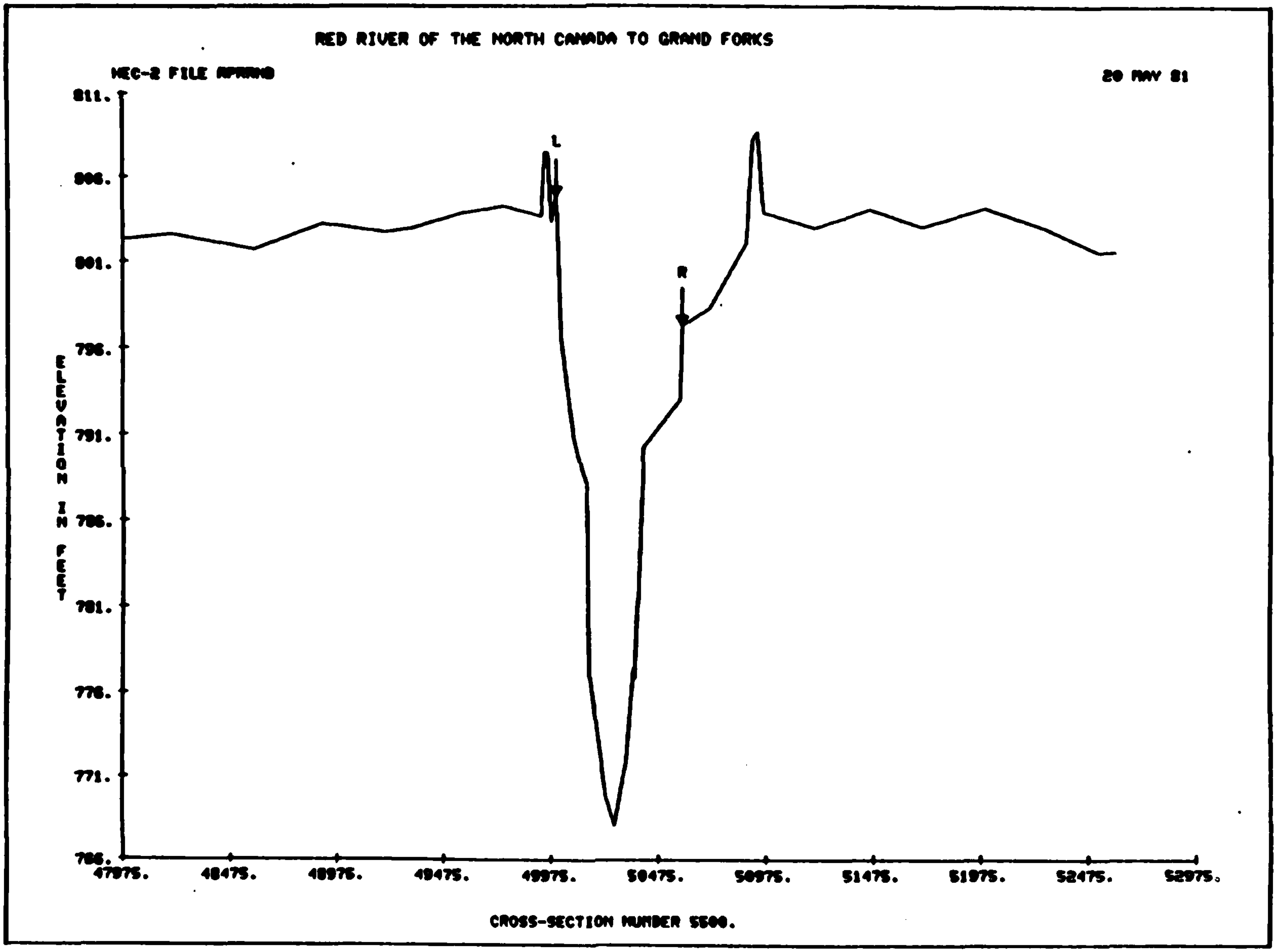
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ELEVATION IN FEET
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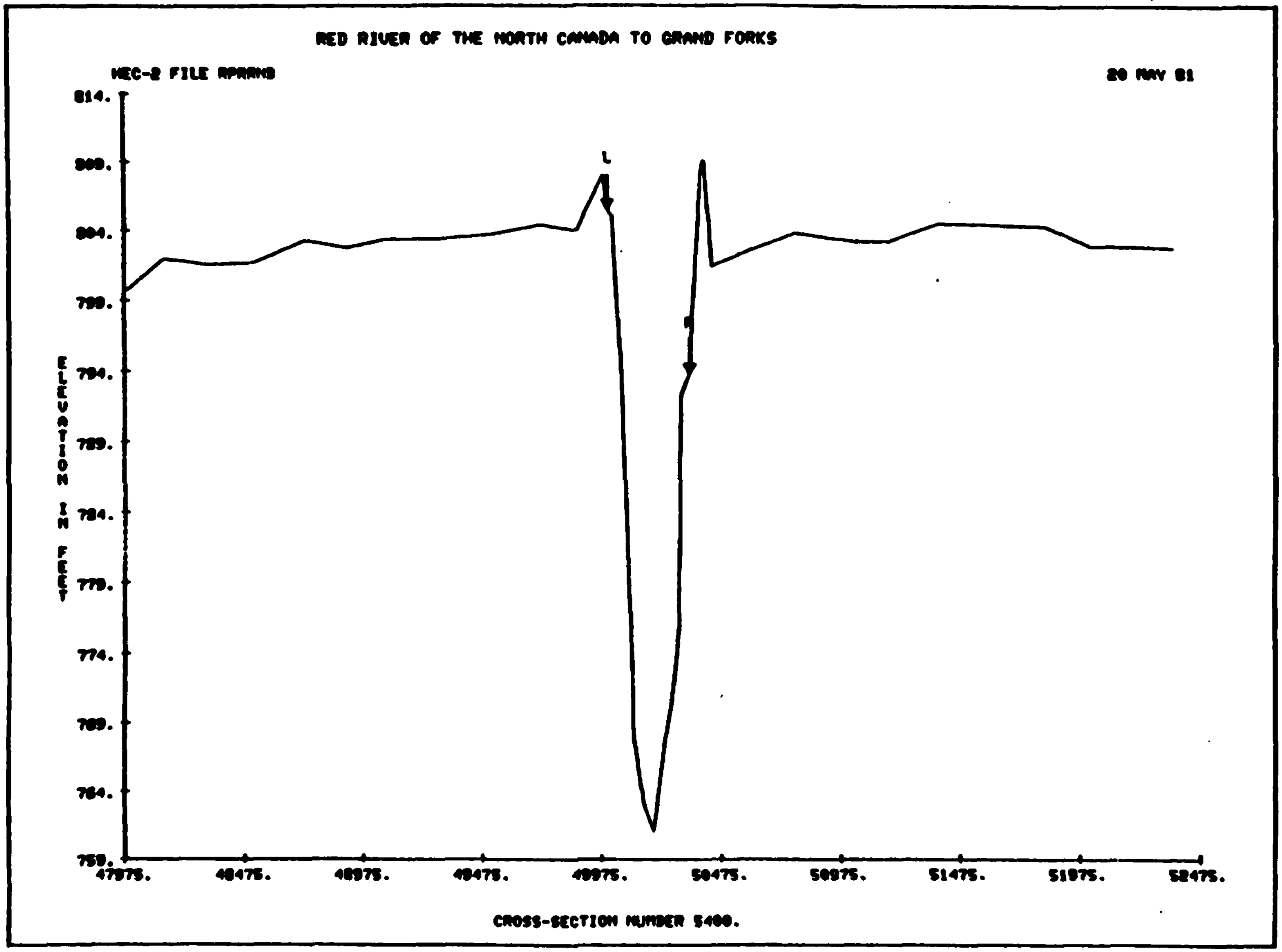
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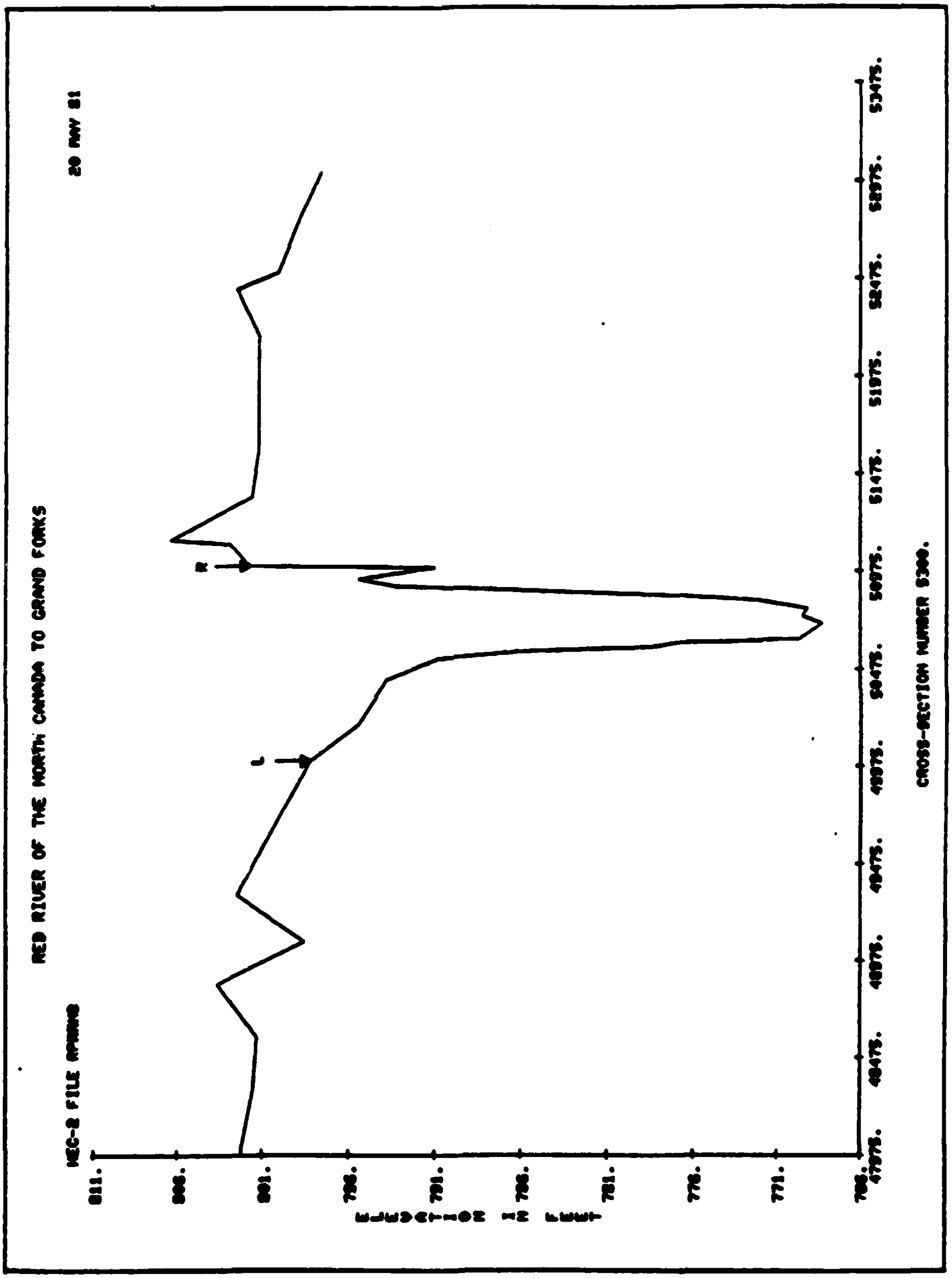
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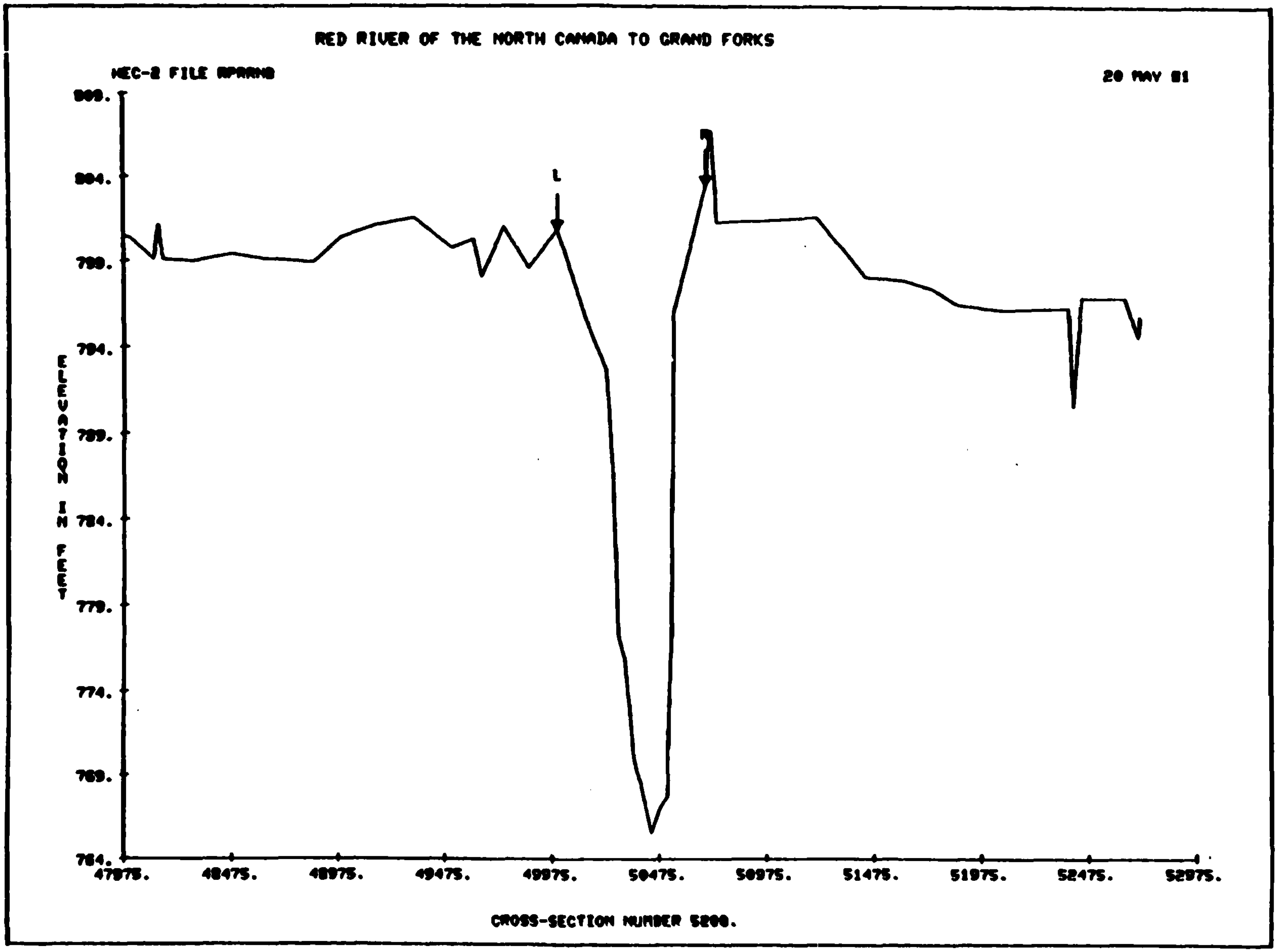
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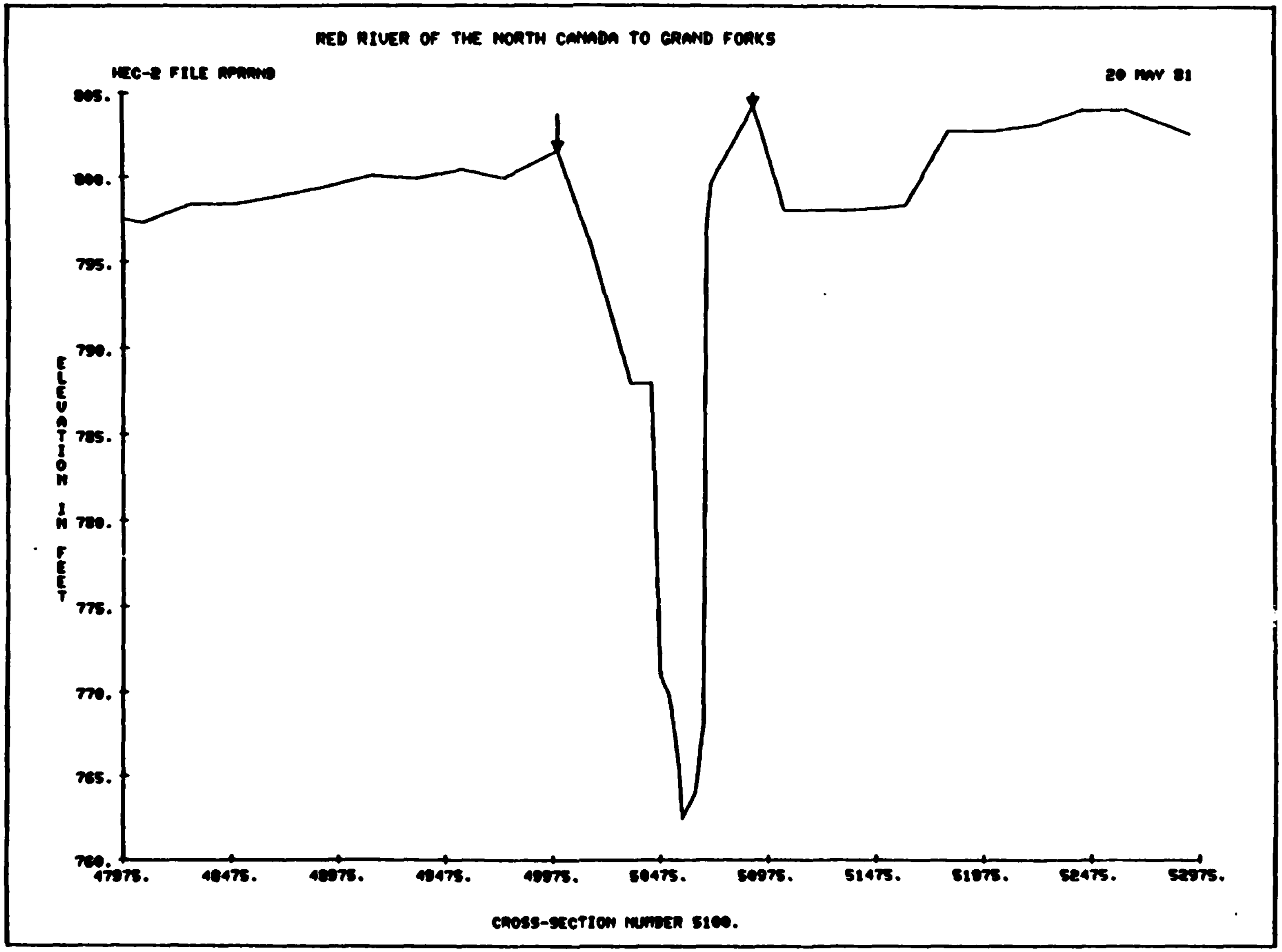
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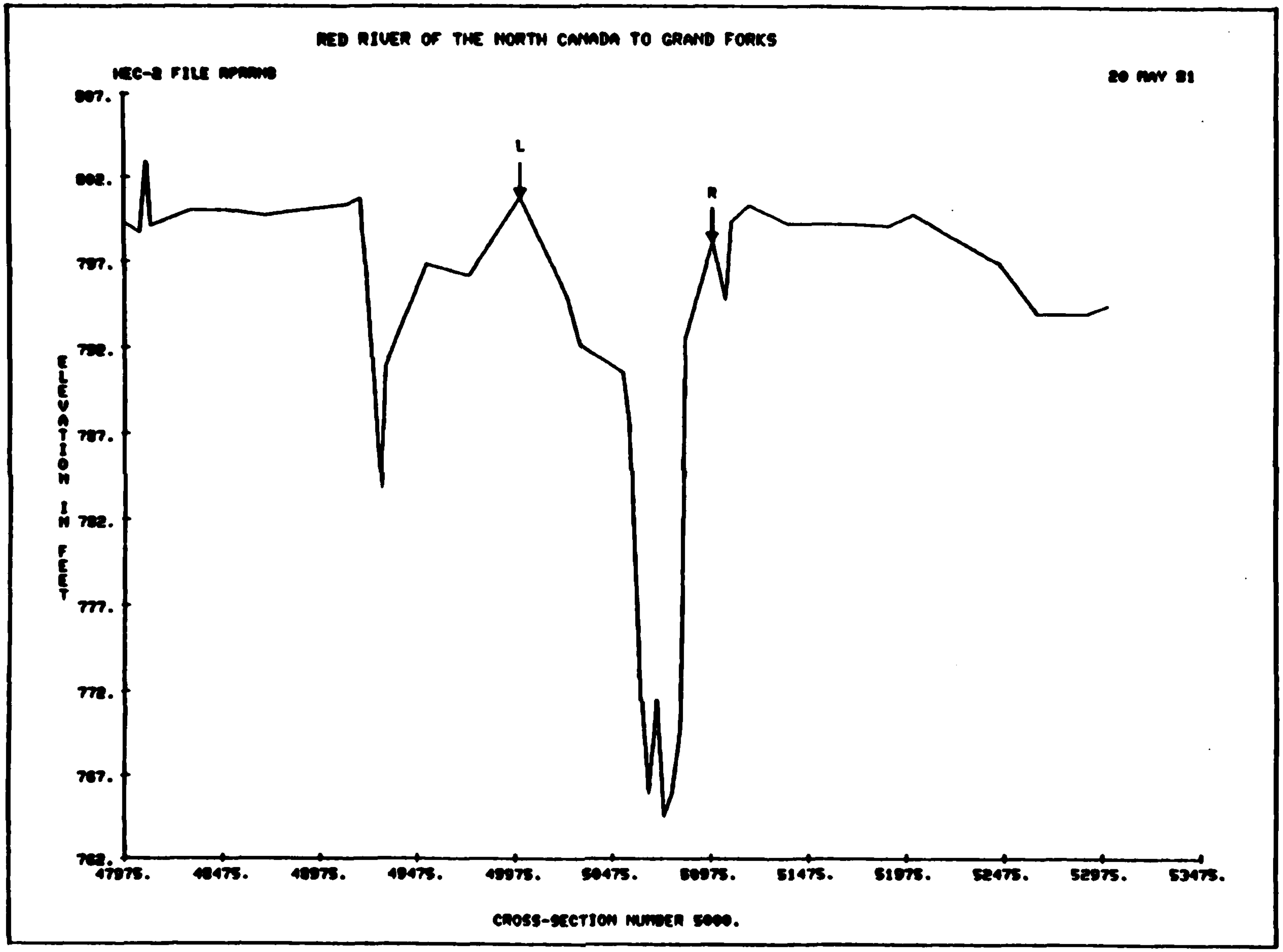
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ELEVATION IN FEET
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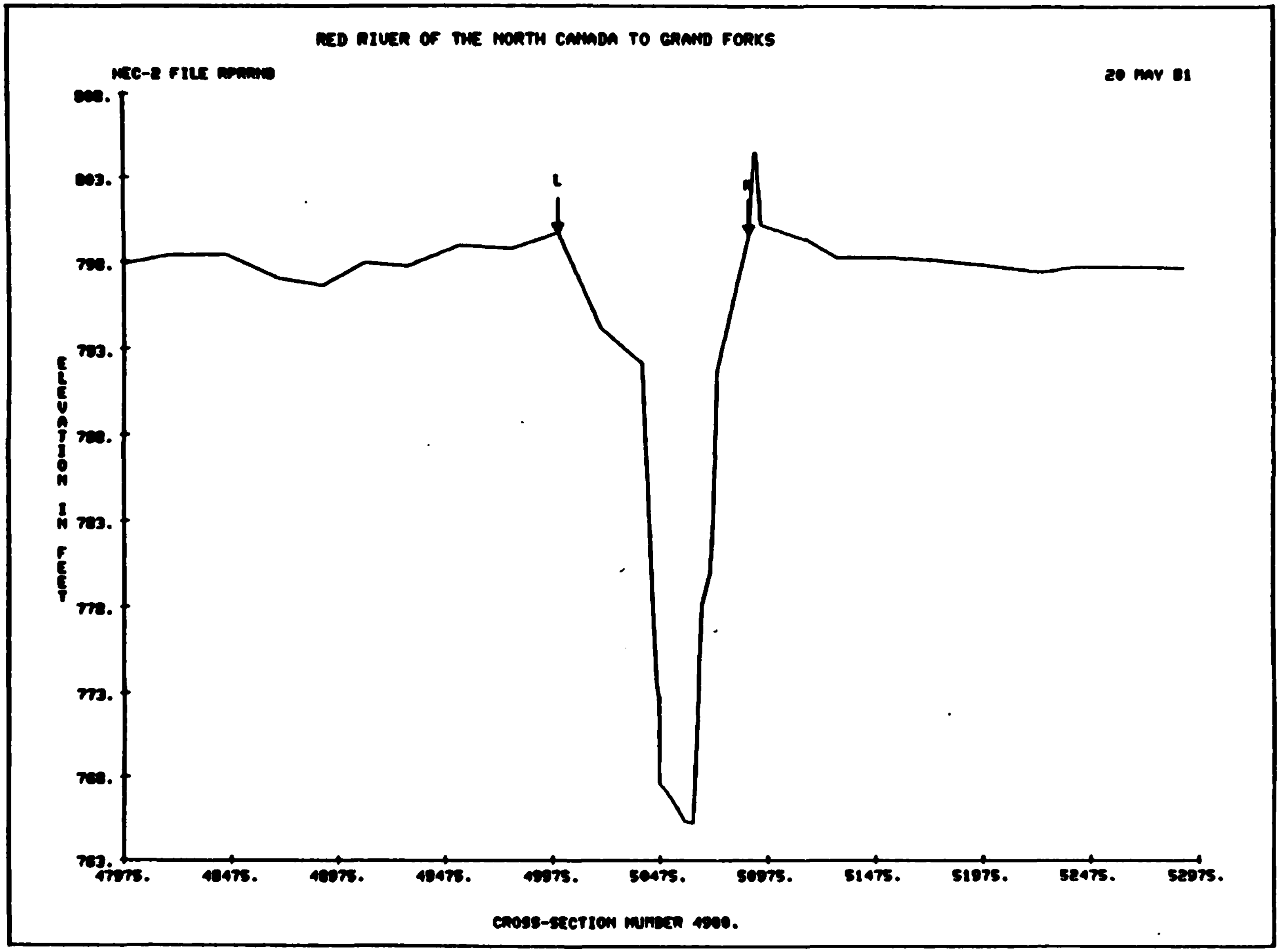

RED RIVER OF THE NORTH CANADA TO GRAND FORKS
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ELEVATION IN FEET
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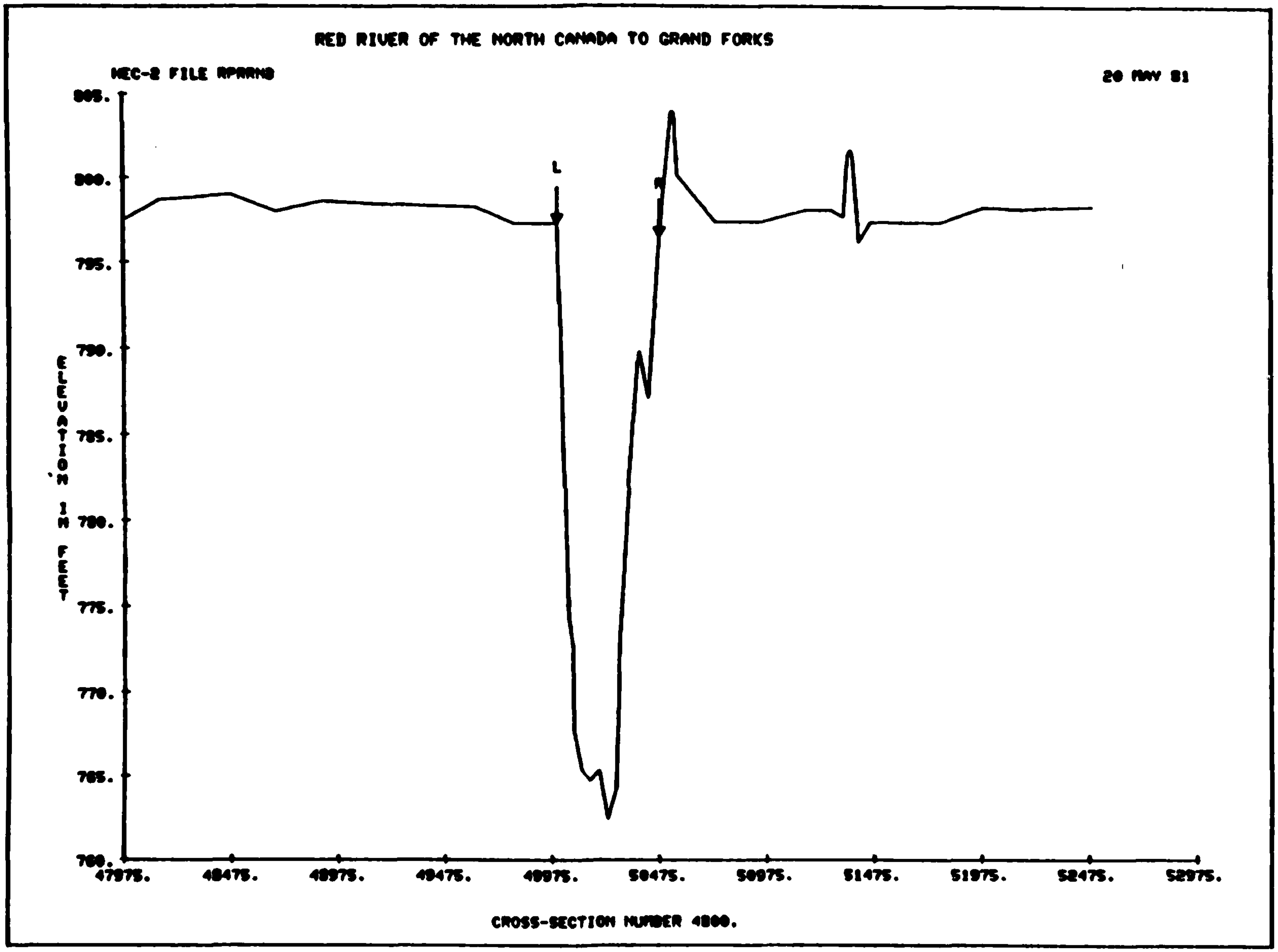
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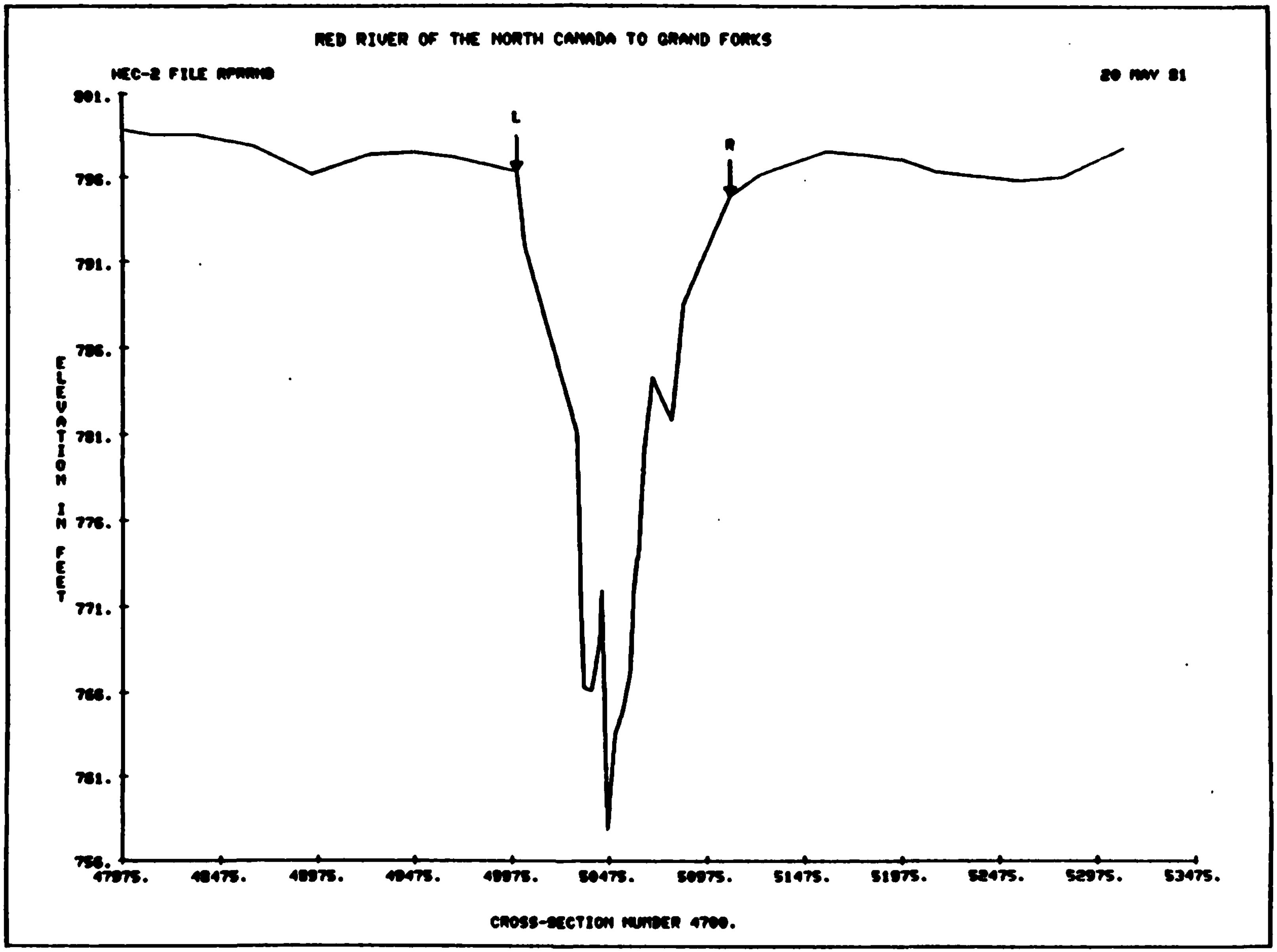

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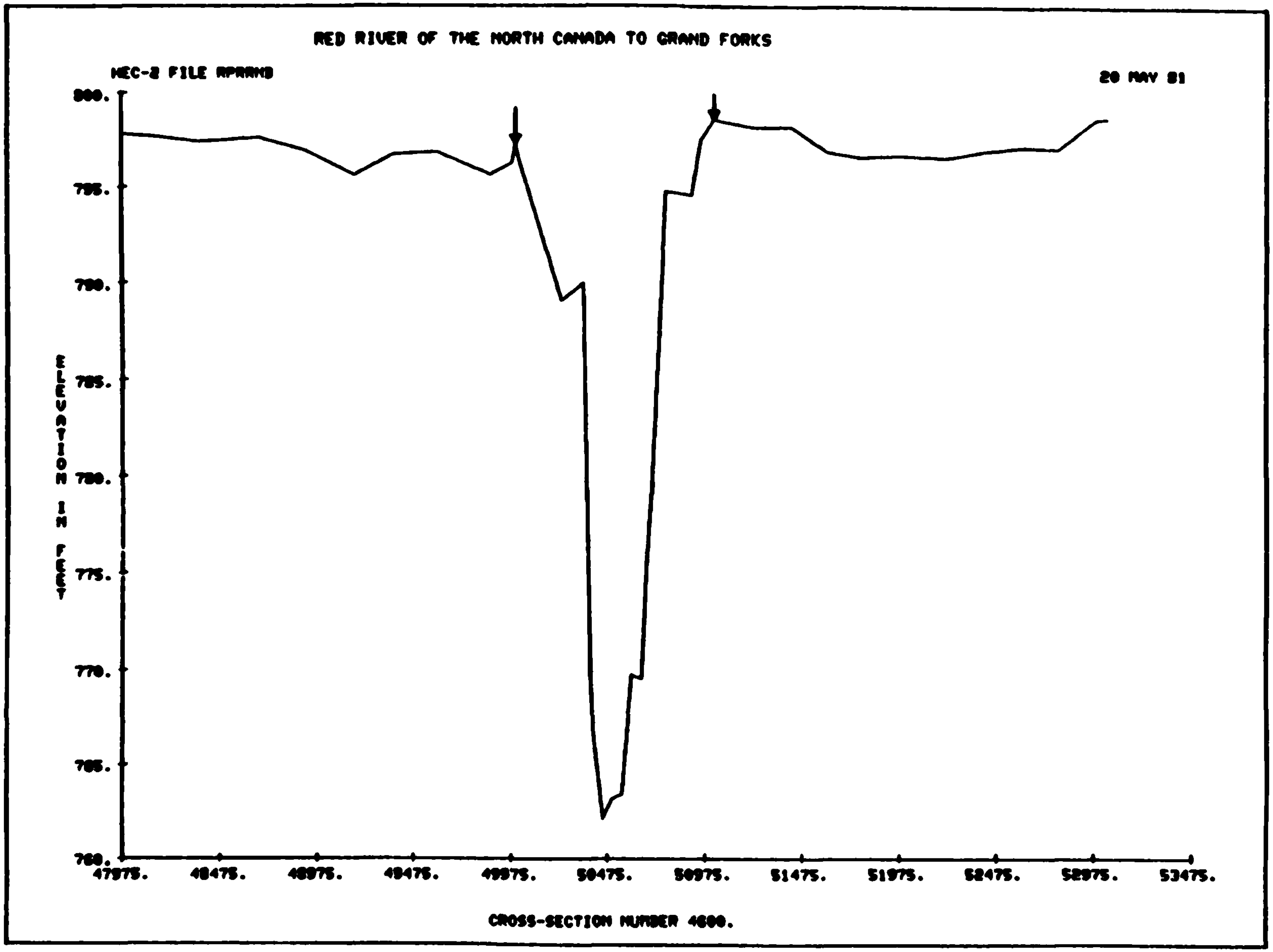
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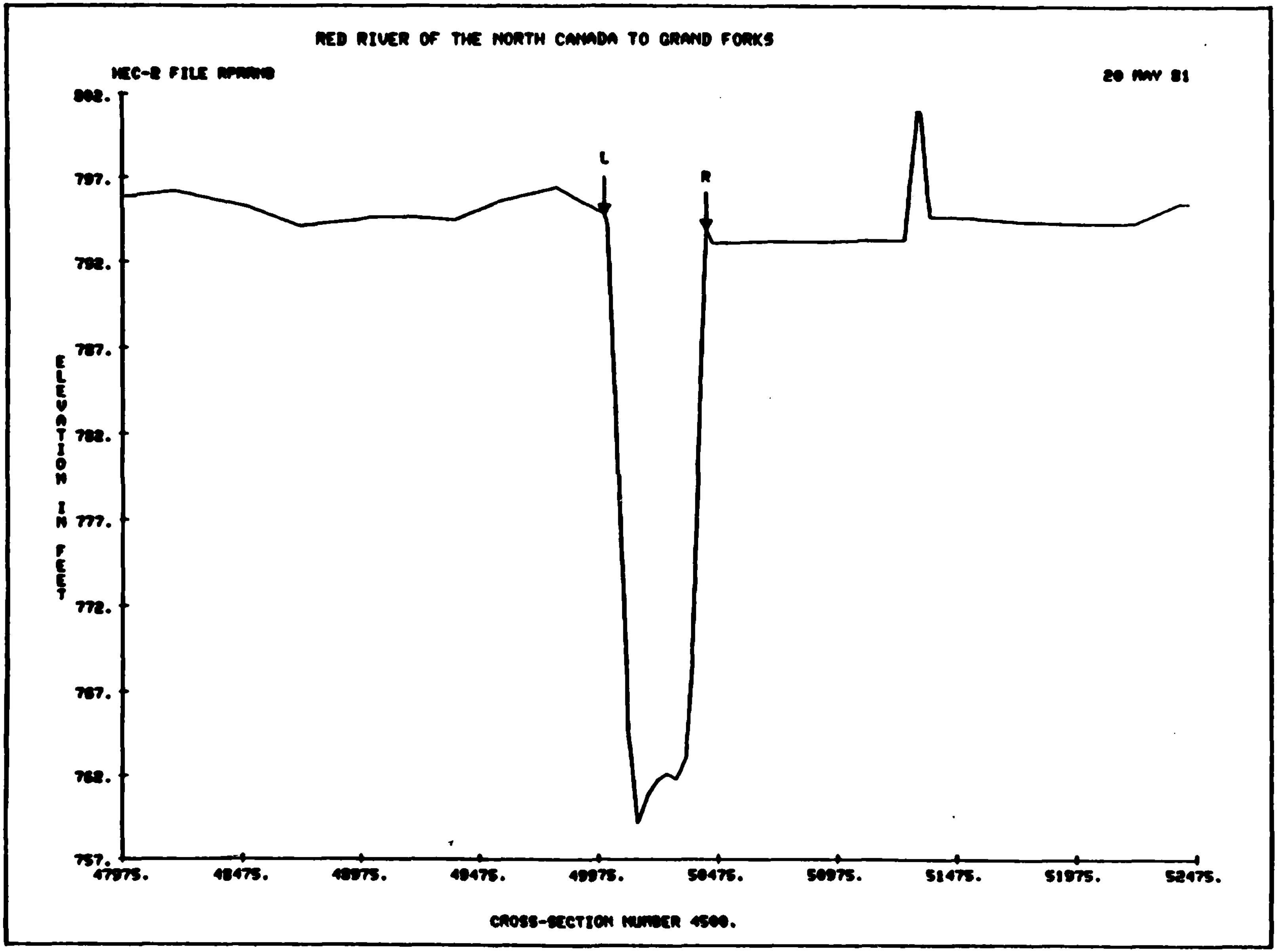
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ELEVATION IN FEET
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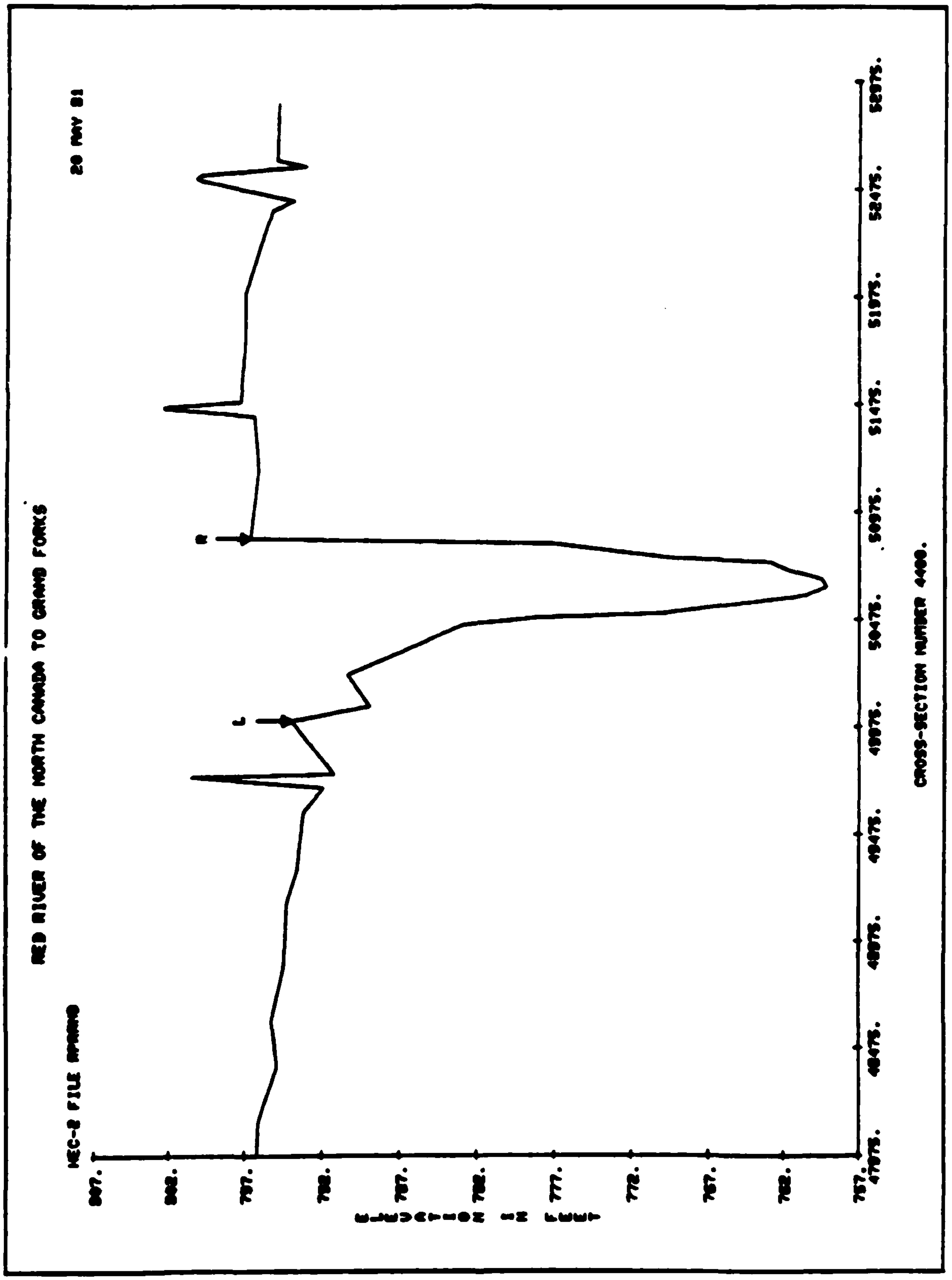
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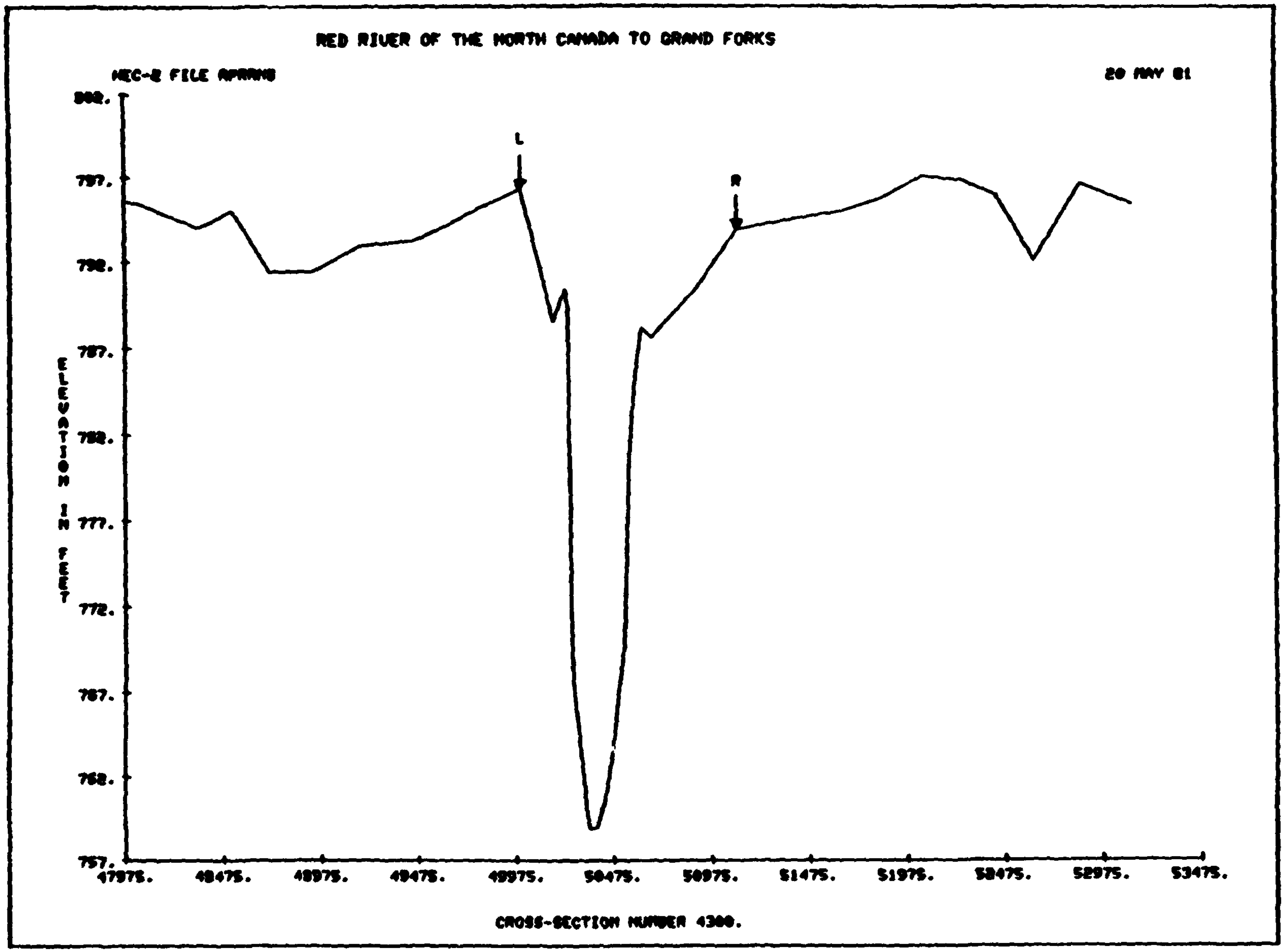
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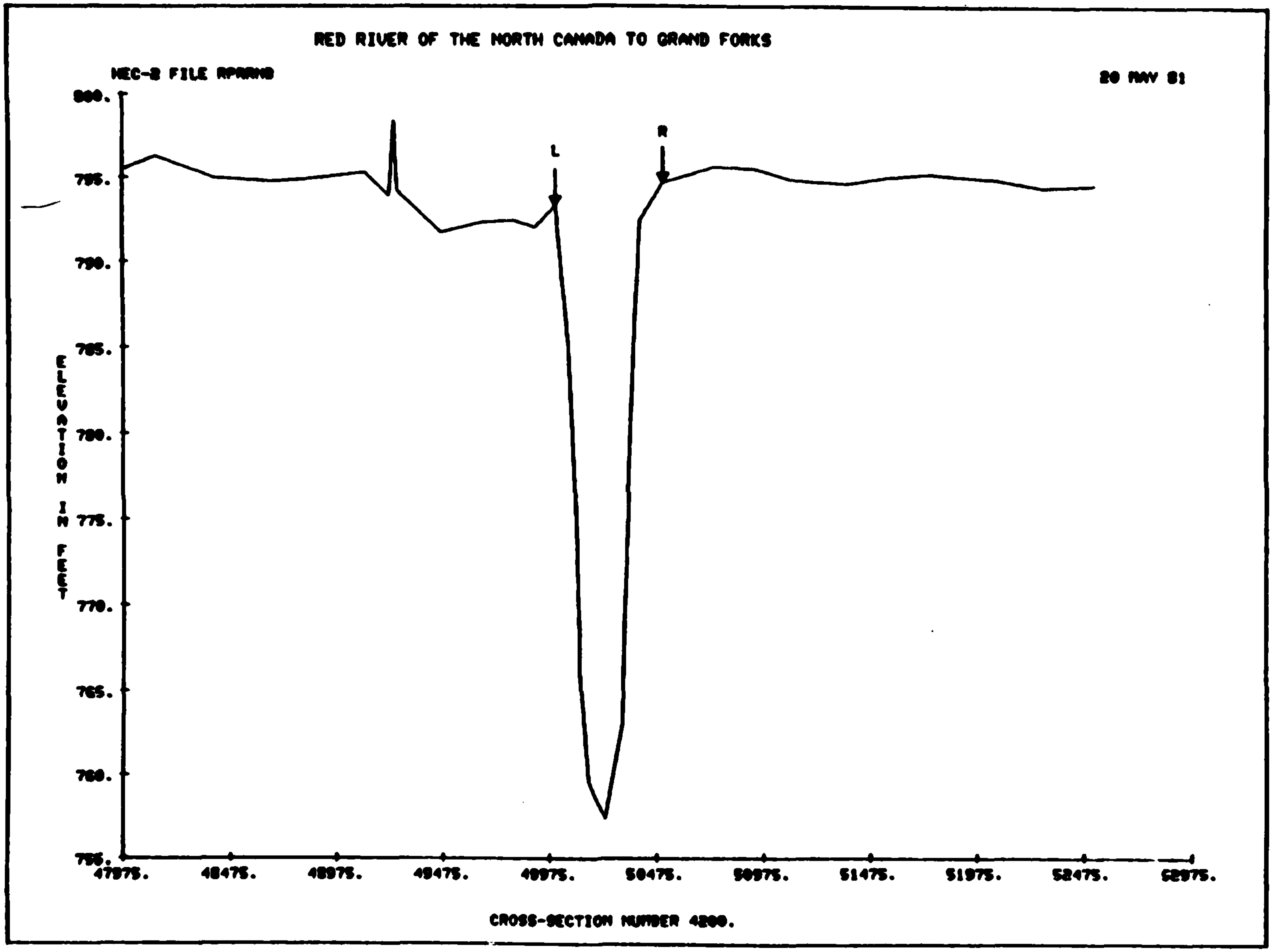

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ELEVATION IN FEET
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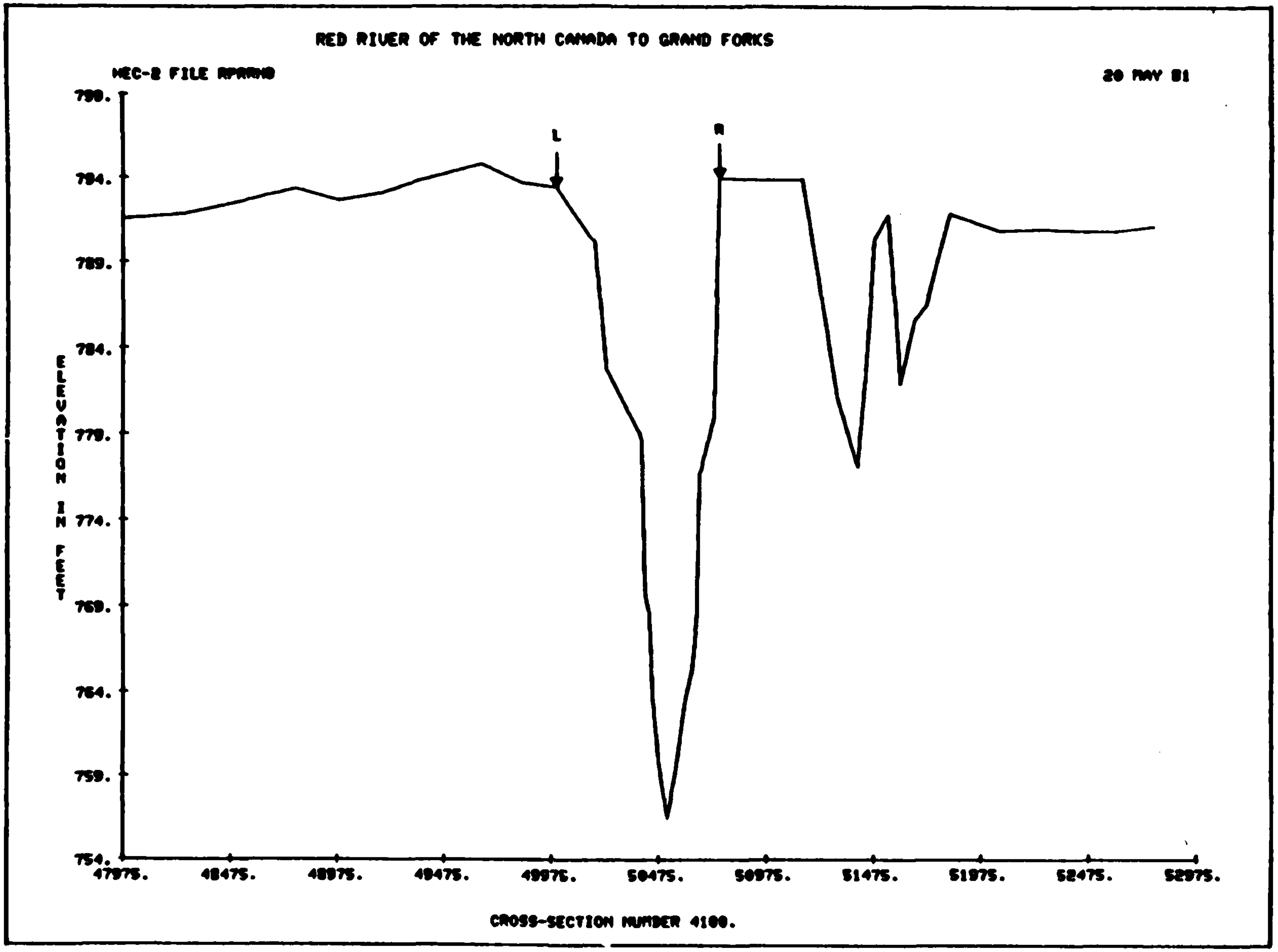
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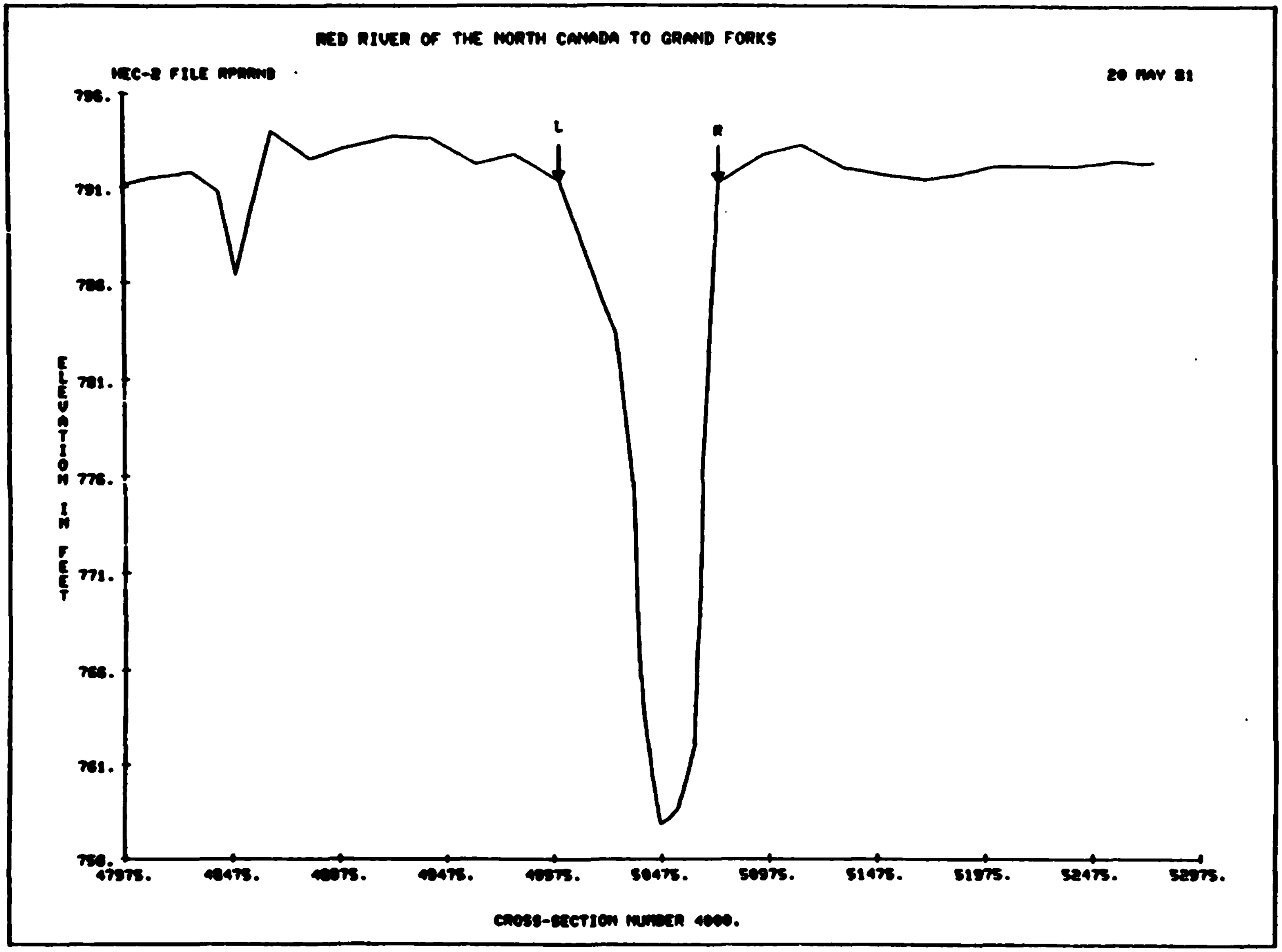
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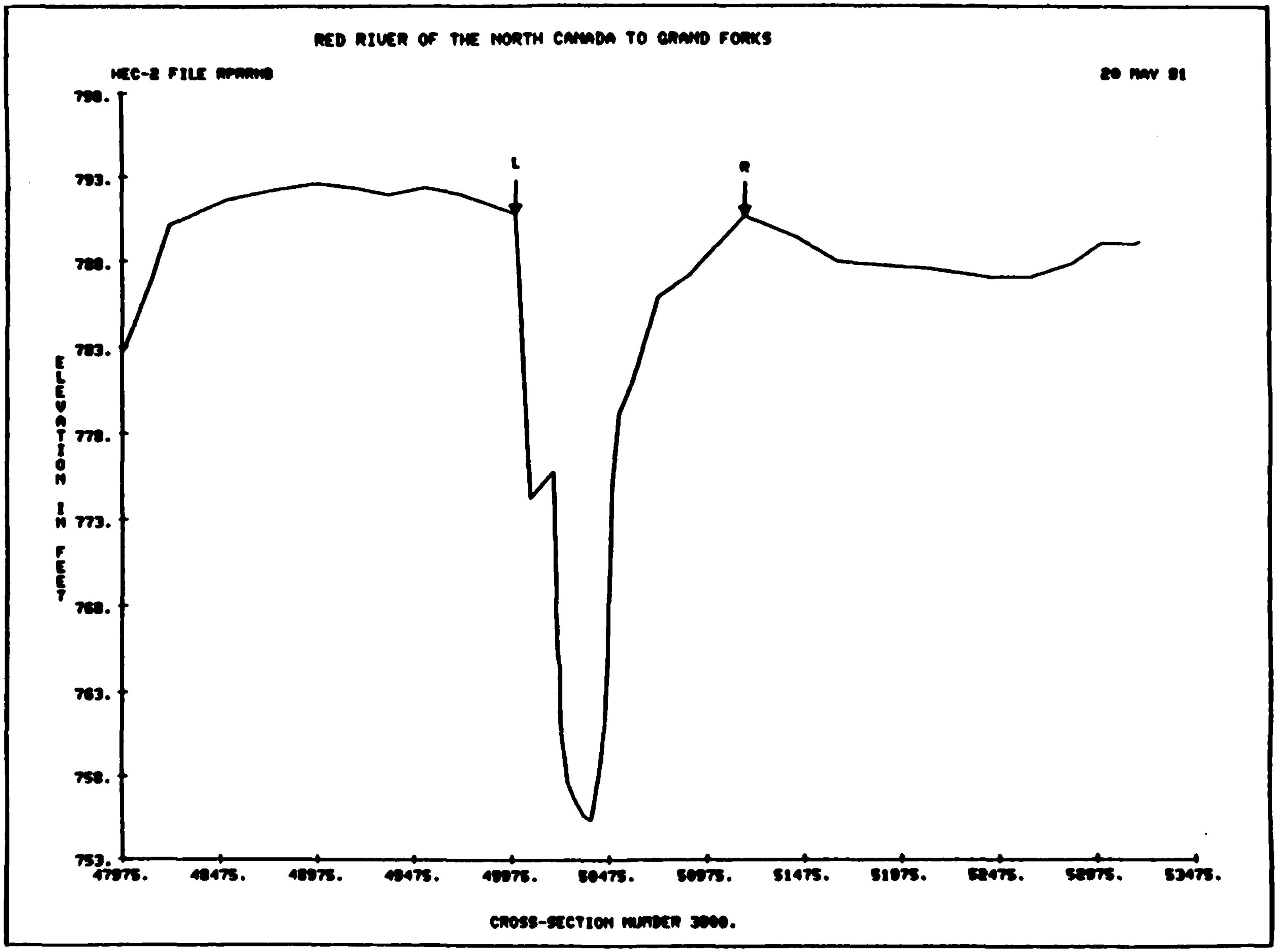
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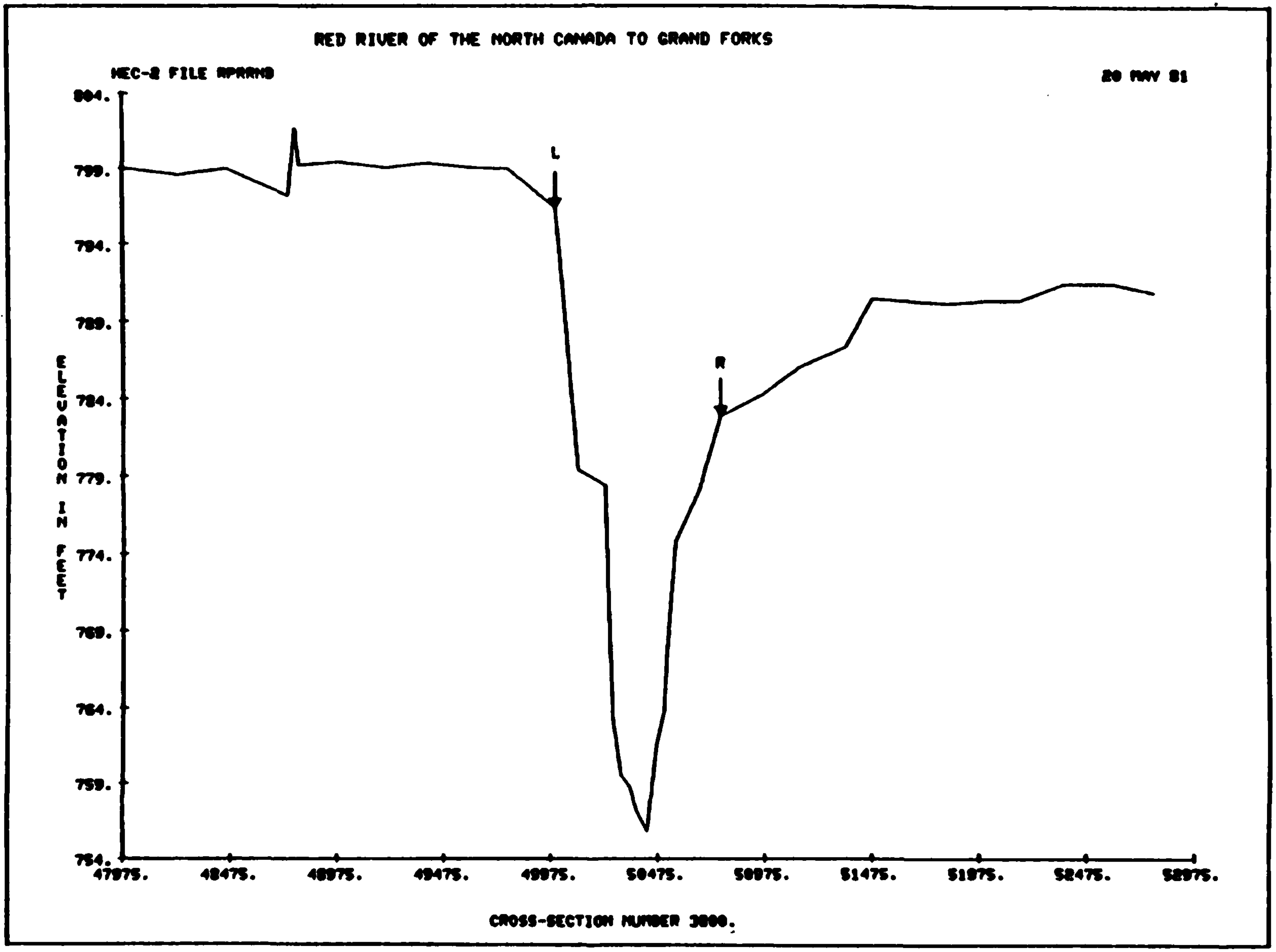
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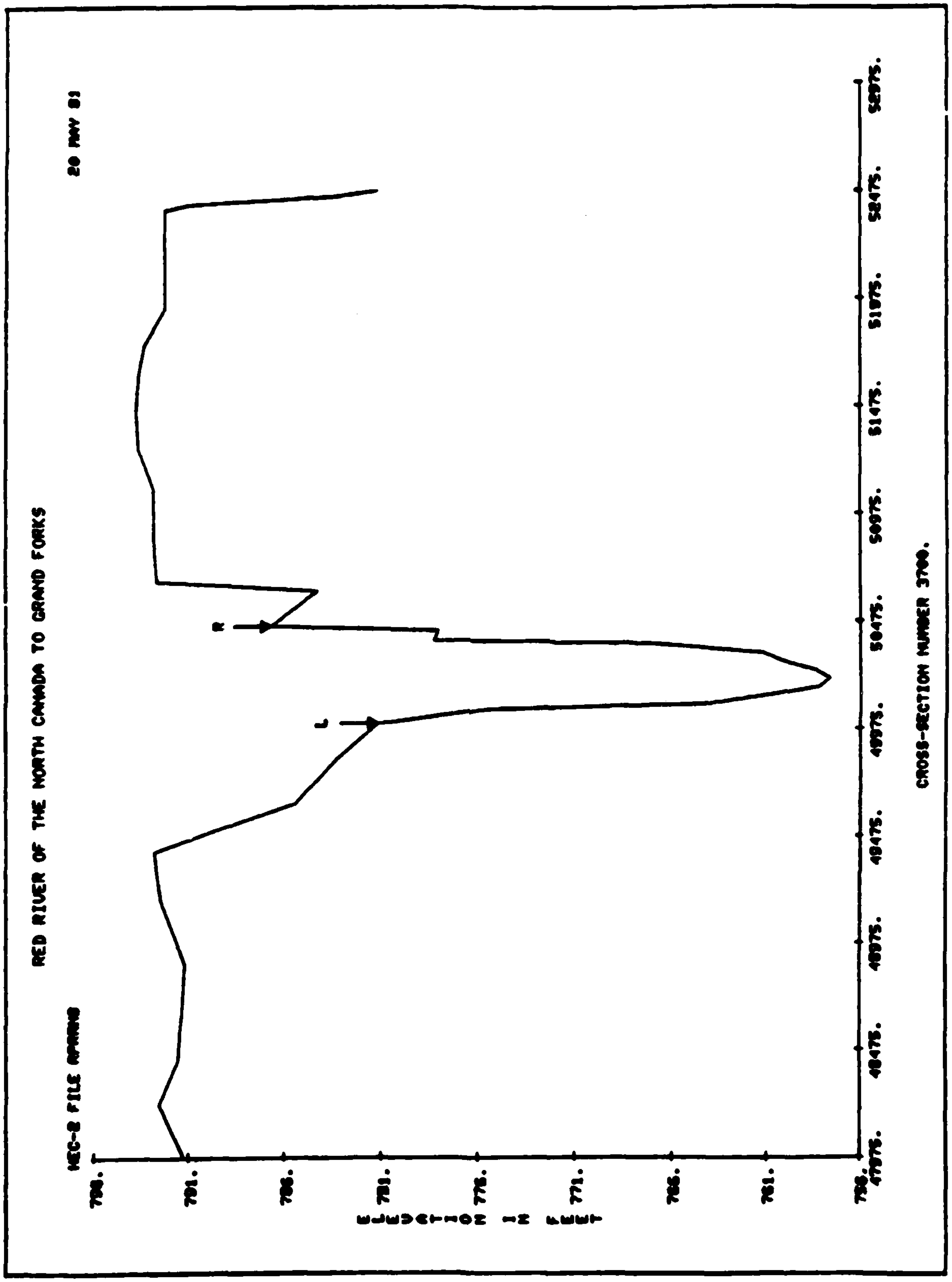
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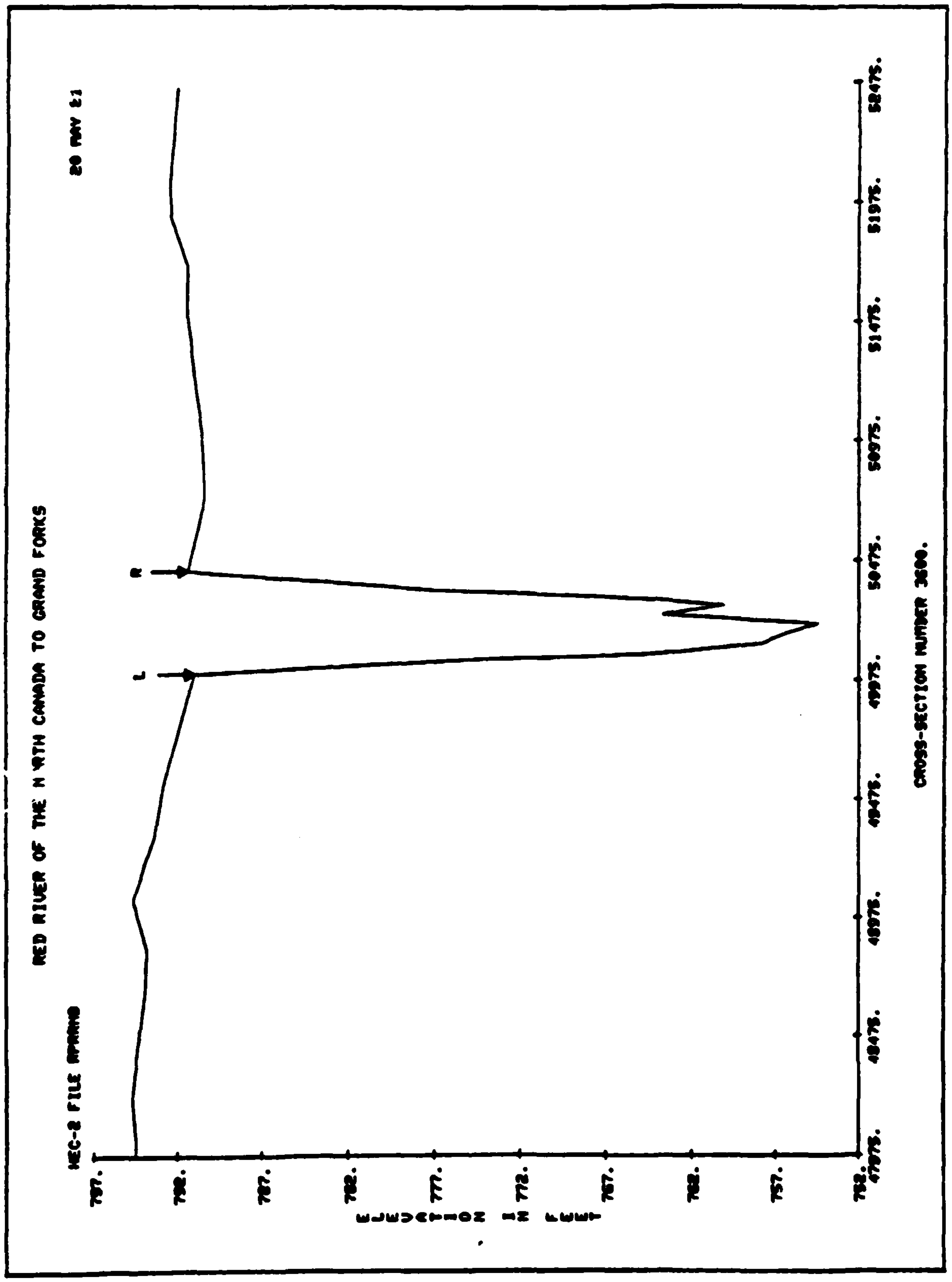
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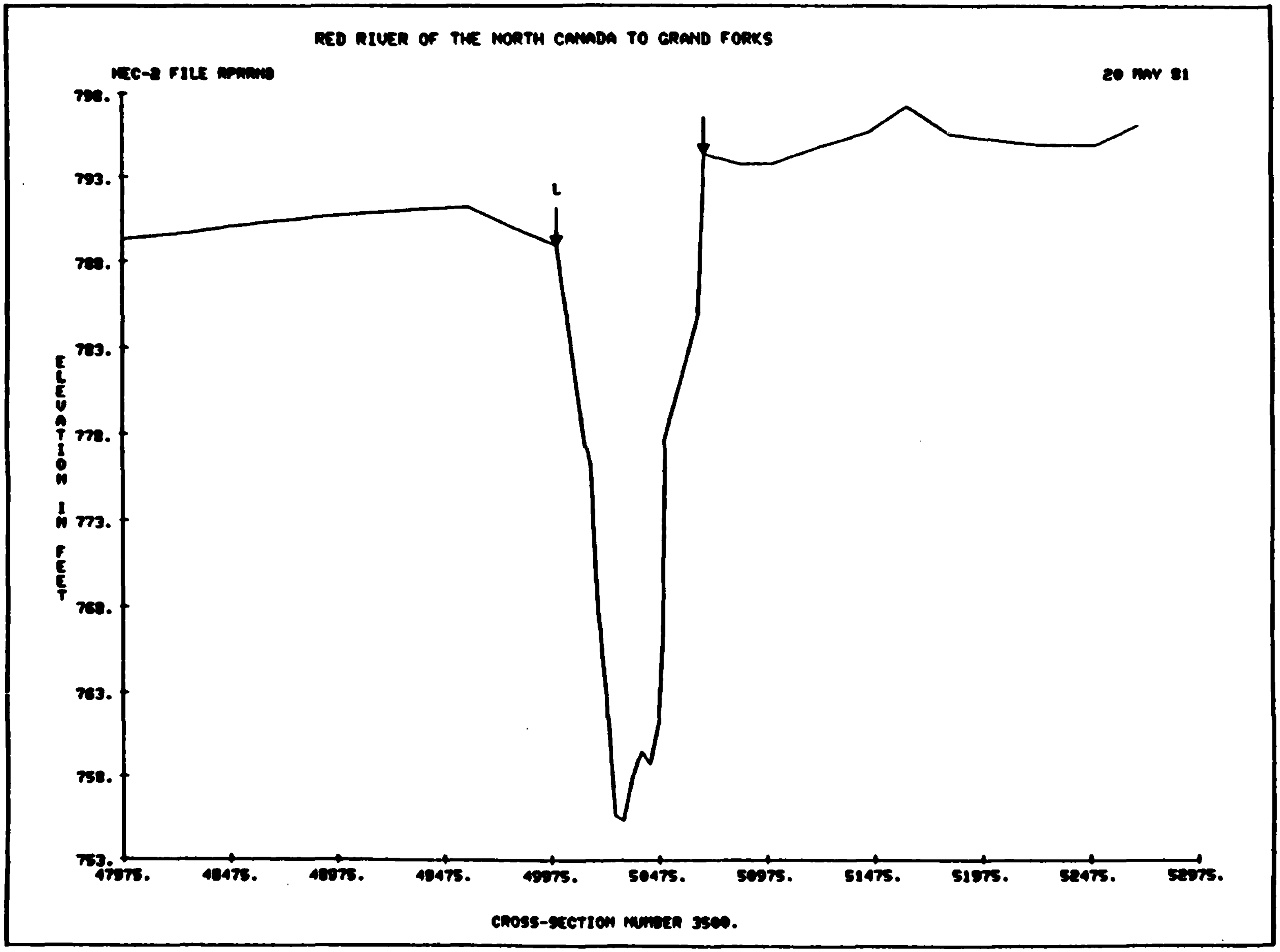
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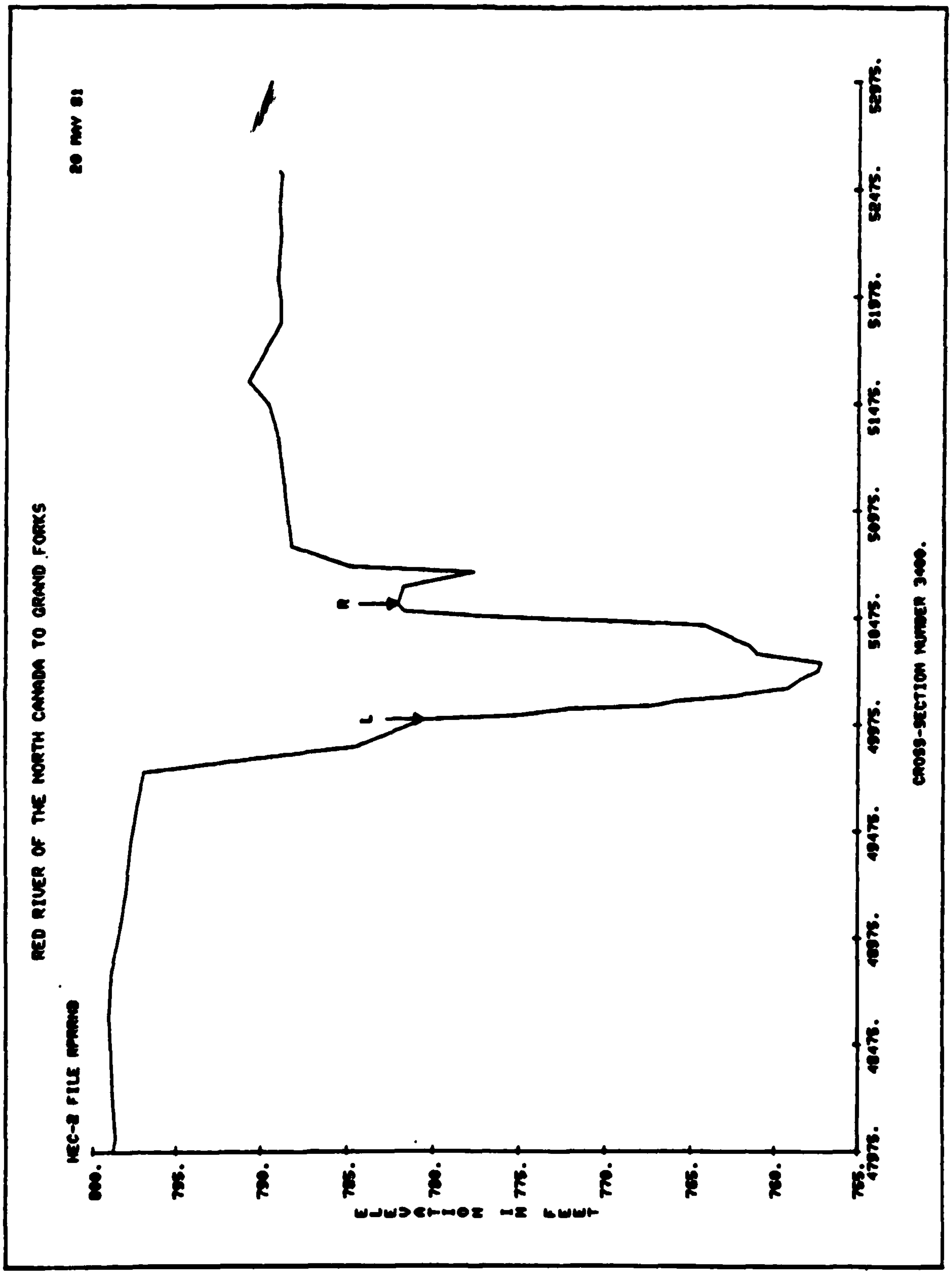
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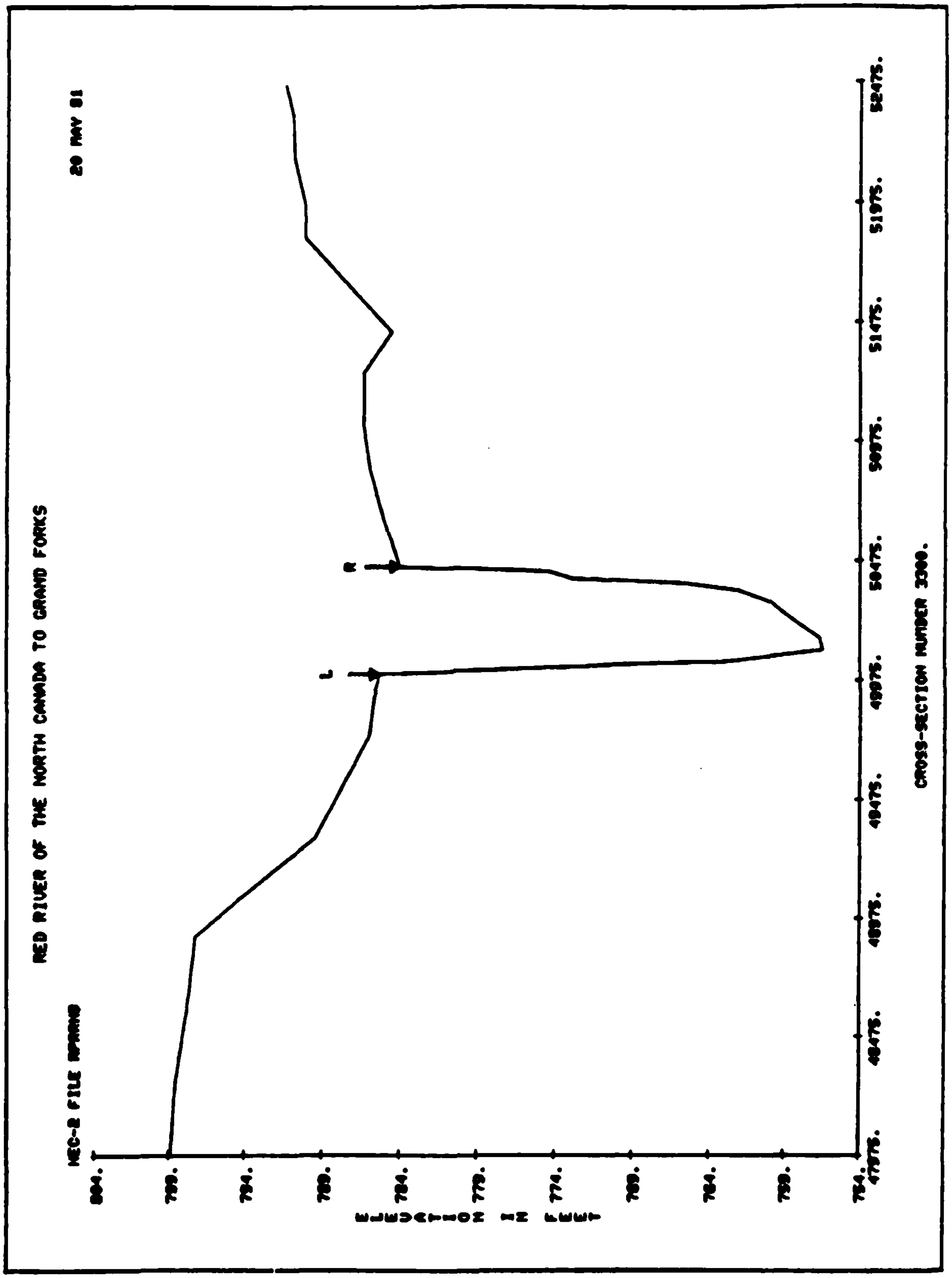
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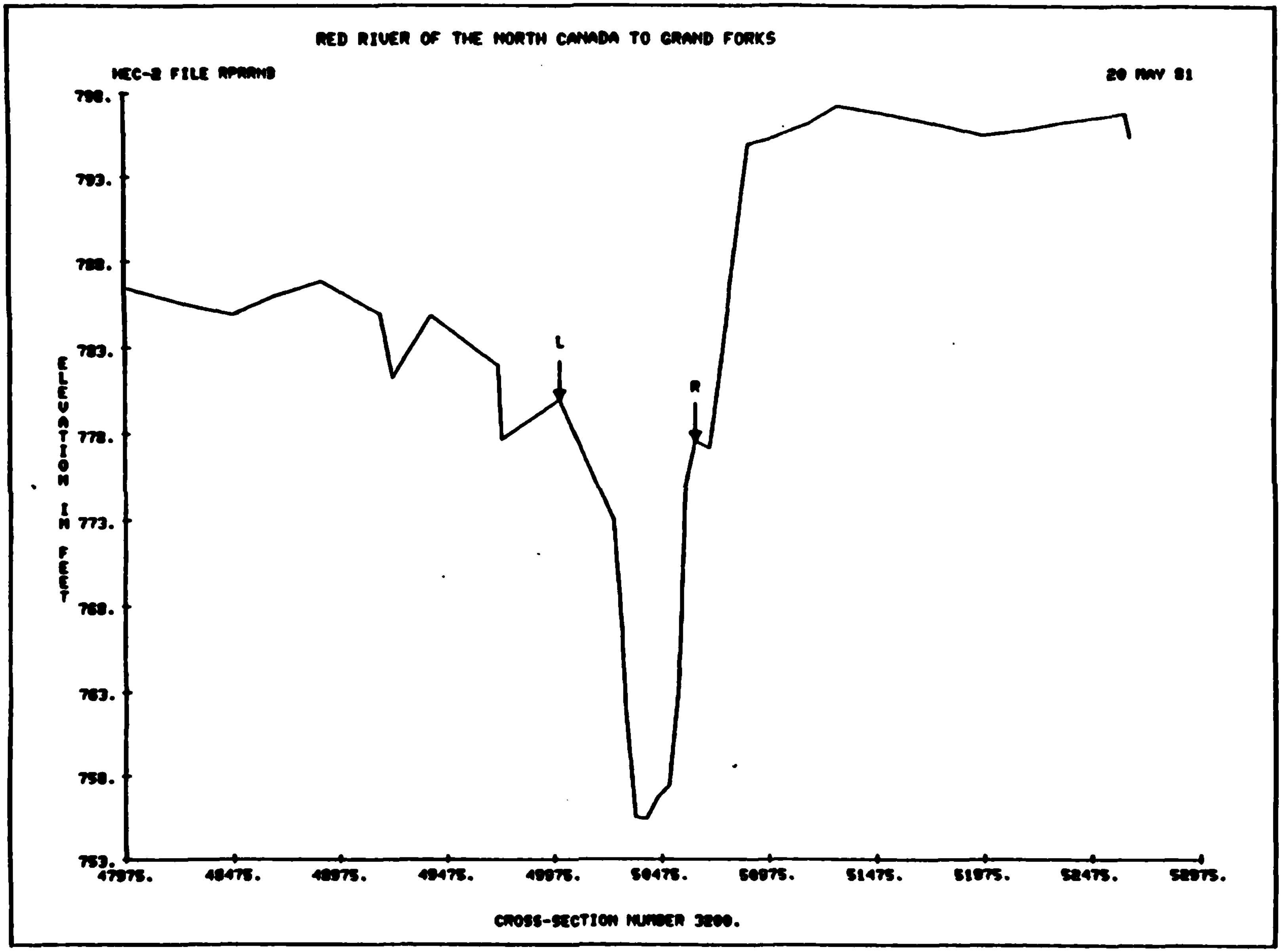

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ELEVATION IN FEET
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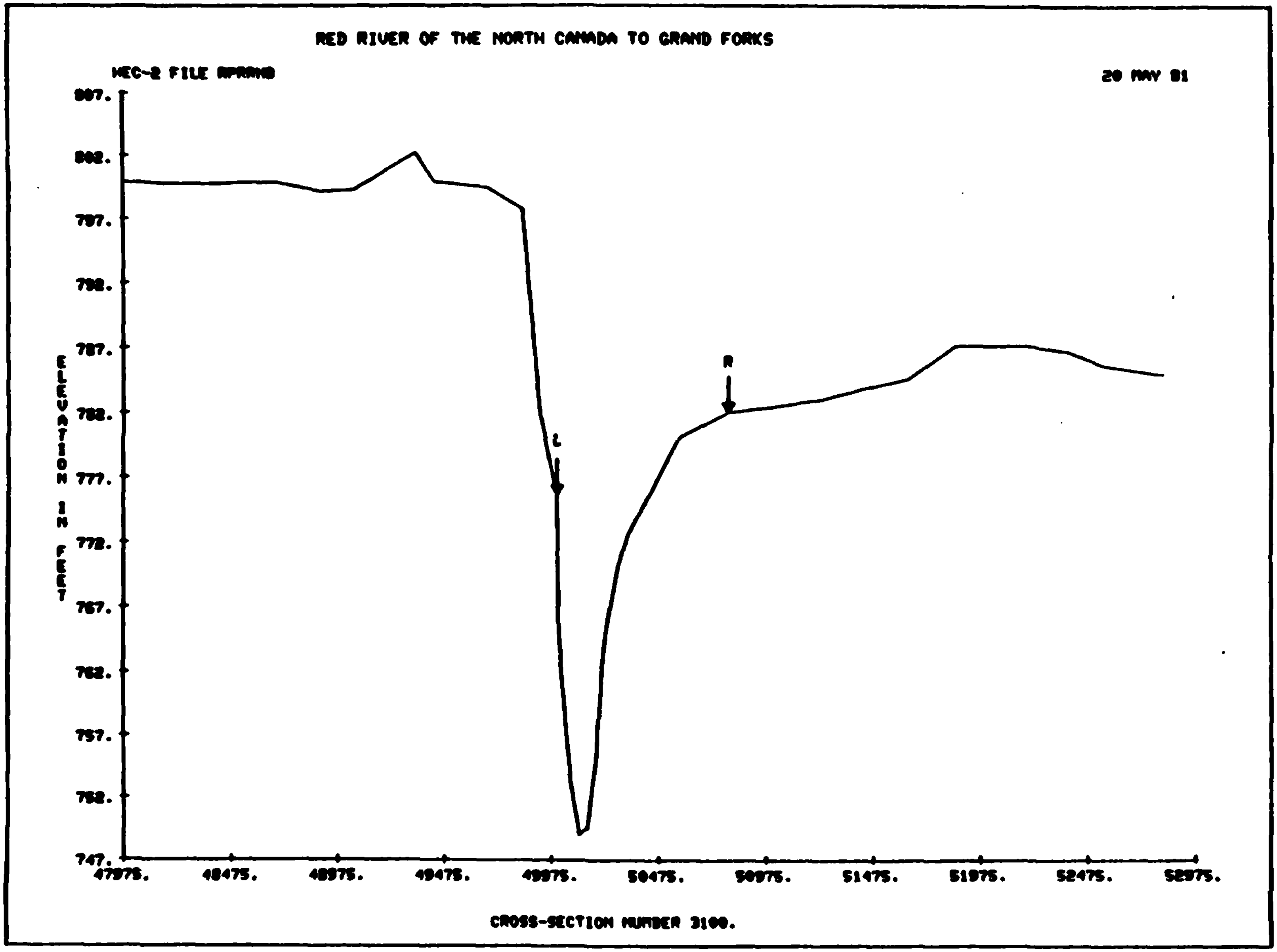
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ELEVATION IN FEET
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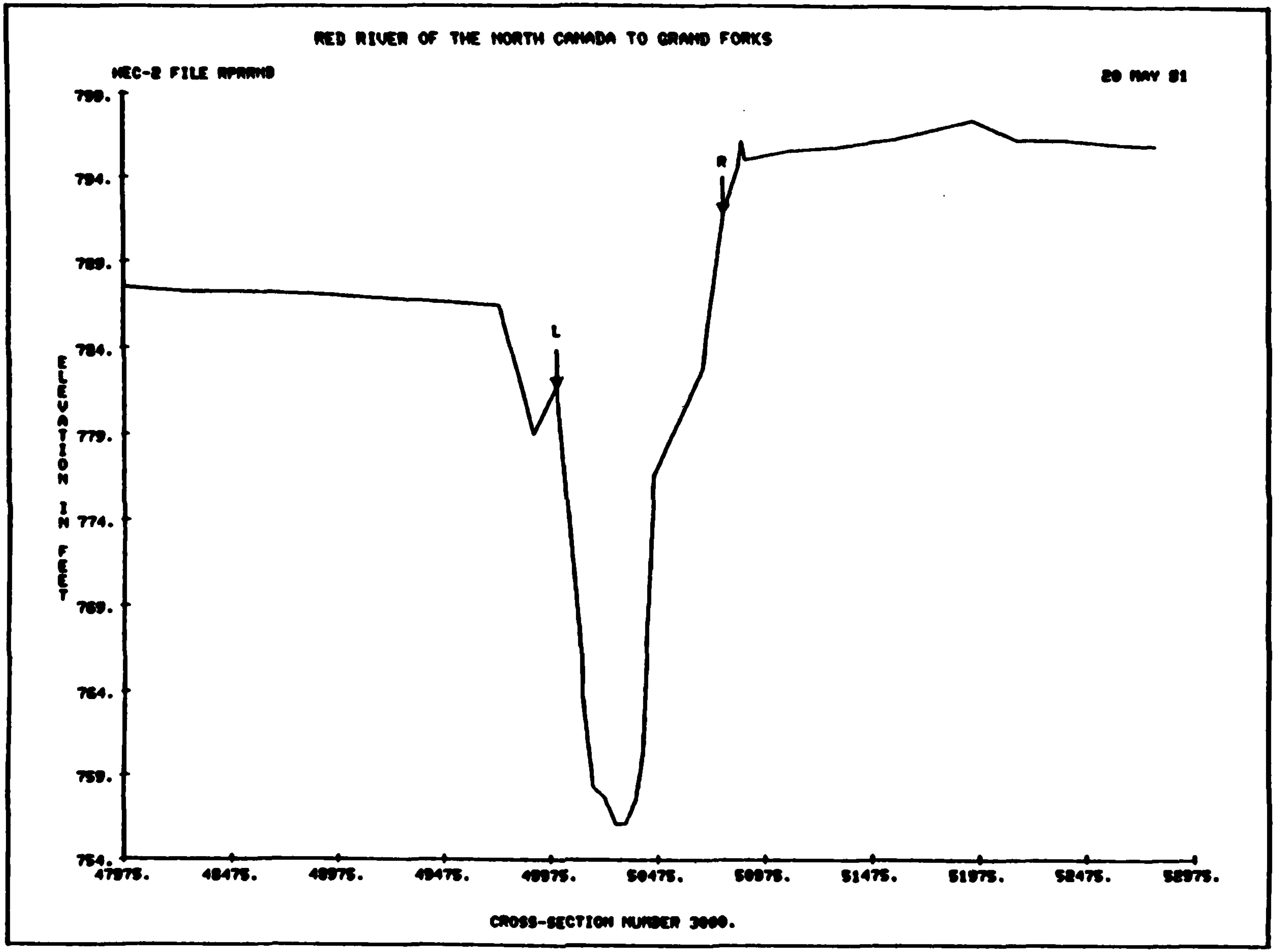
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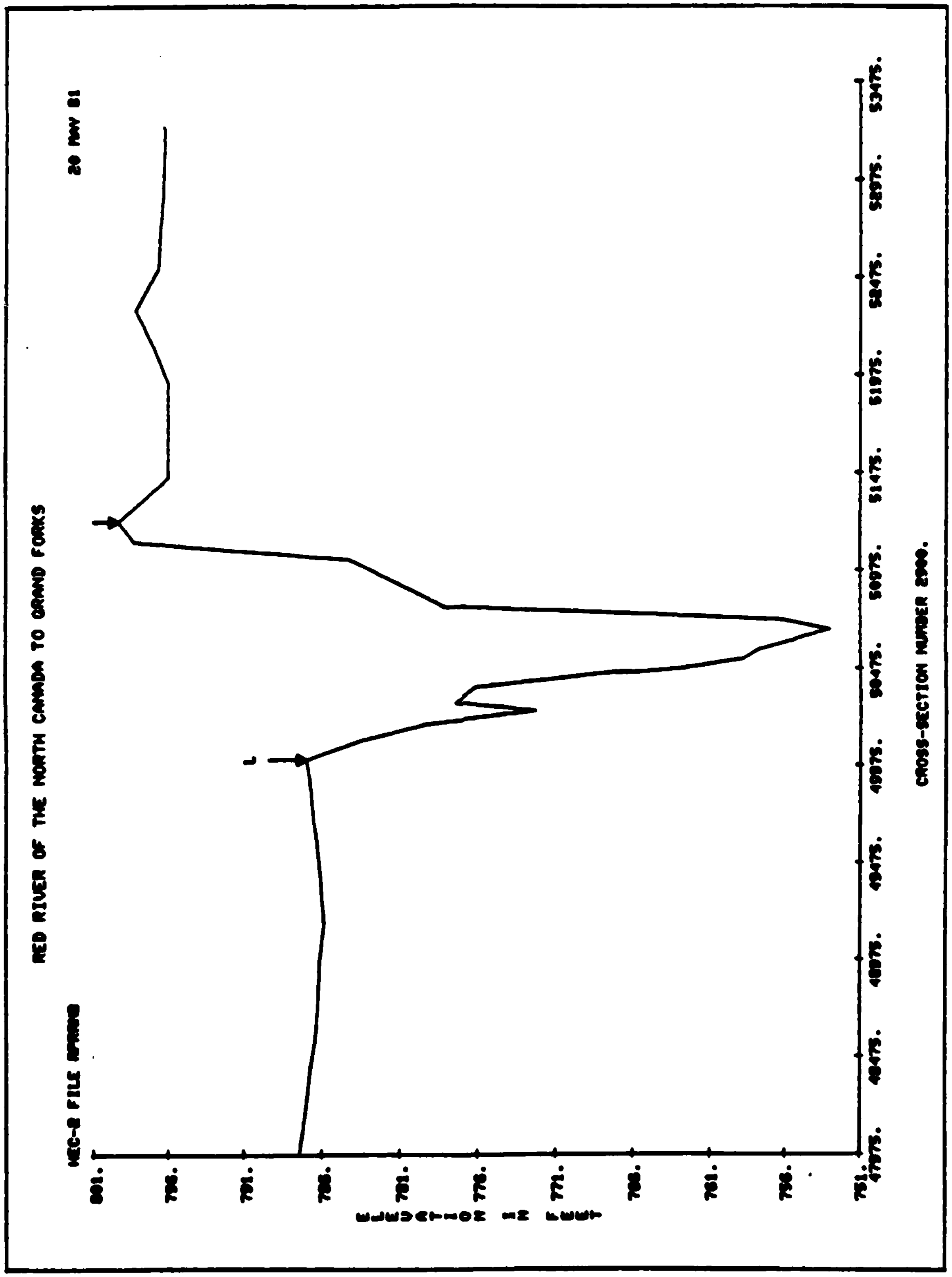
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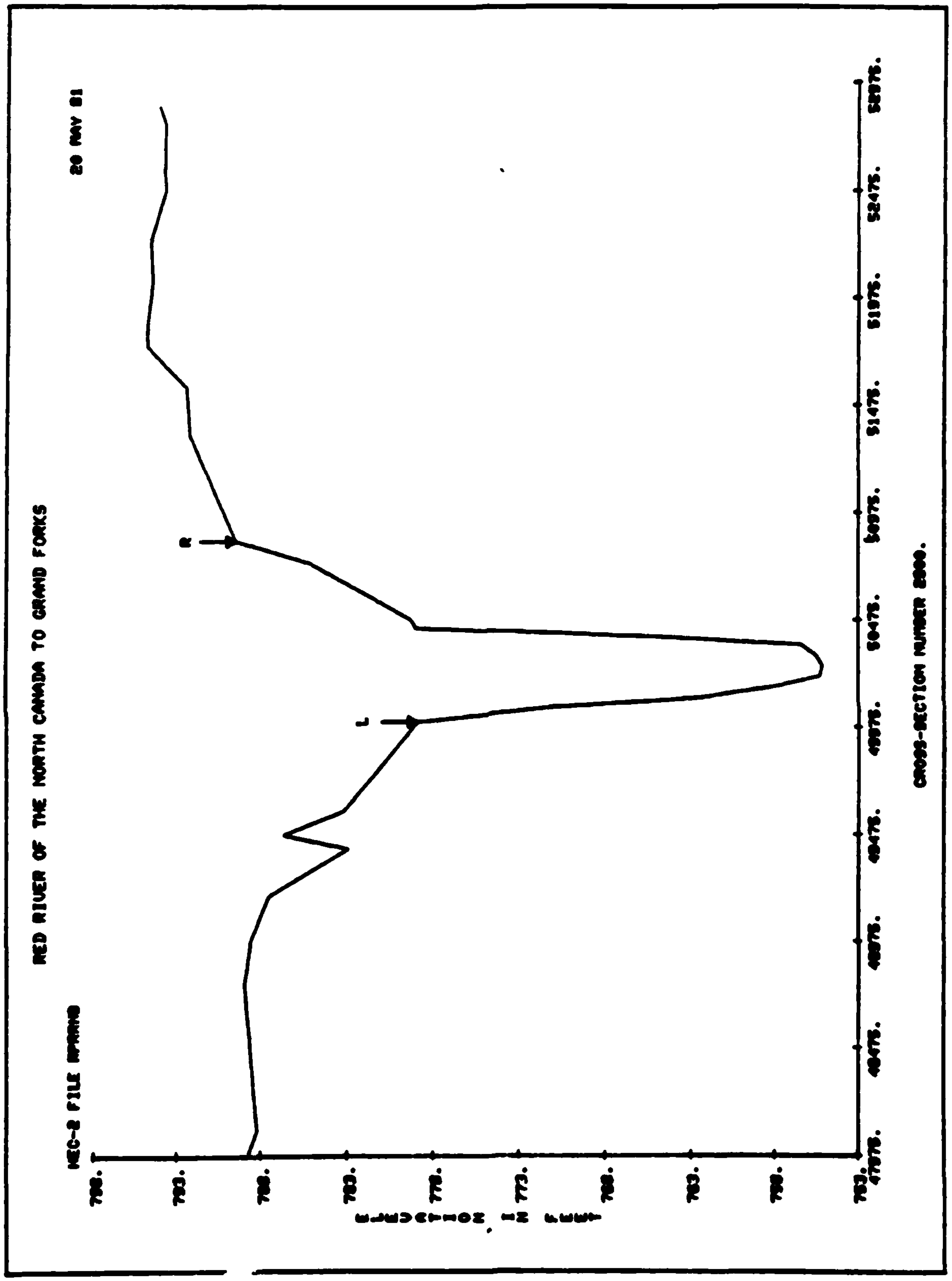
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20 MAY 81
ELEVATION IN FEET
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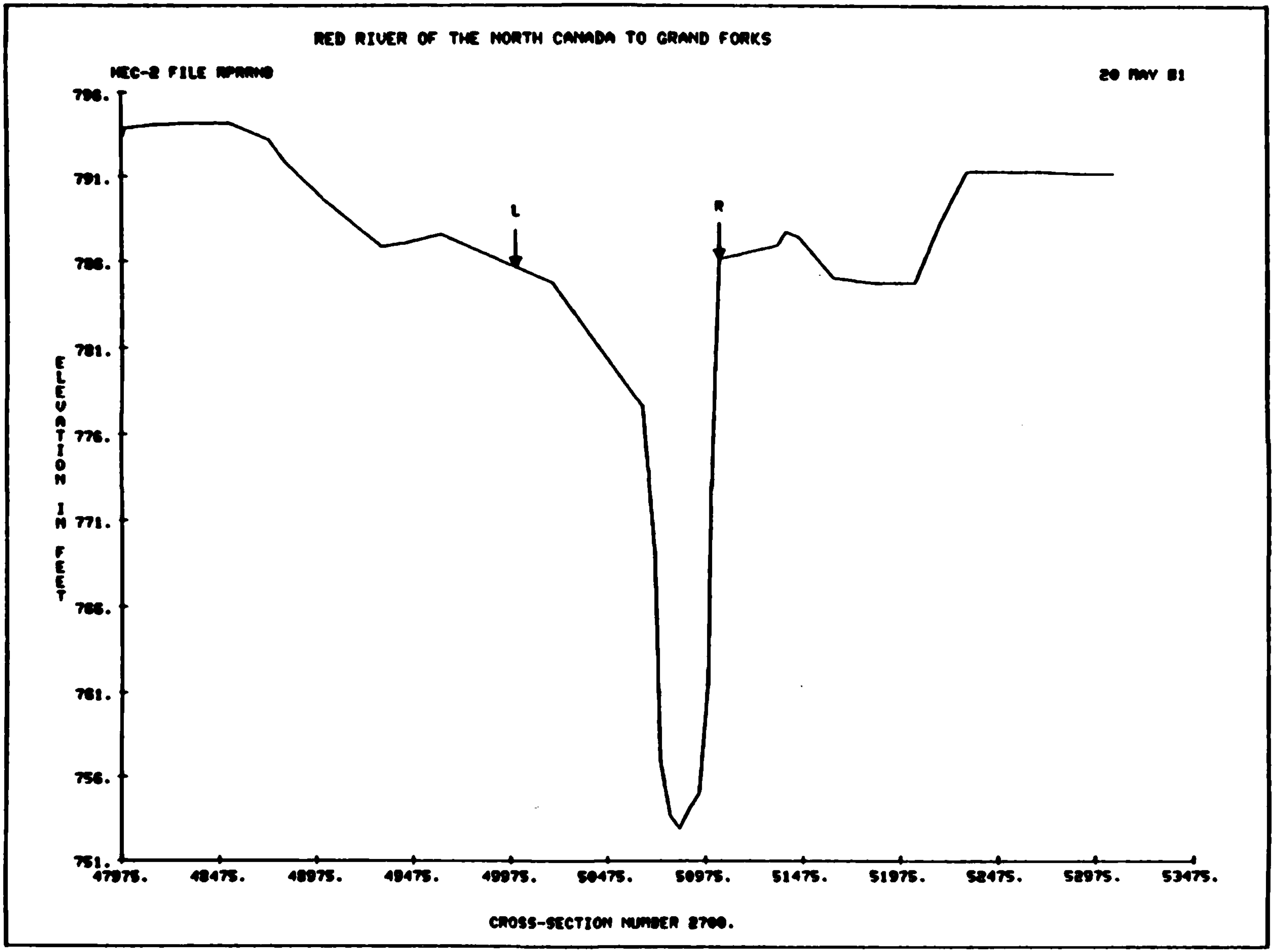
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ELEVATION IN FEET
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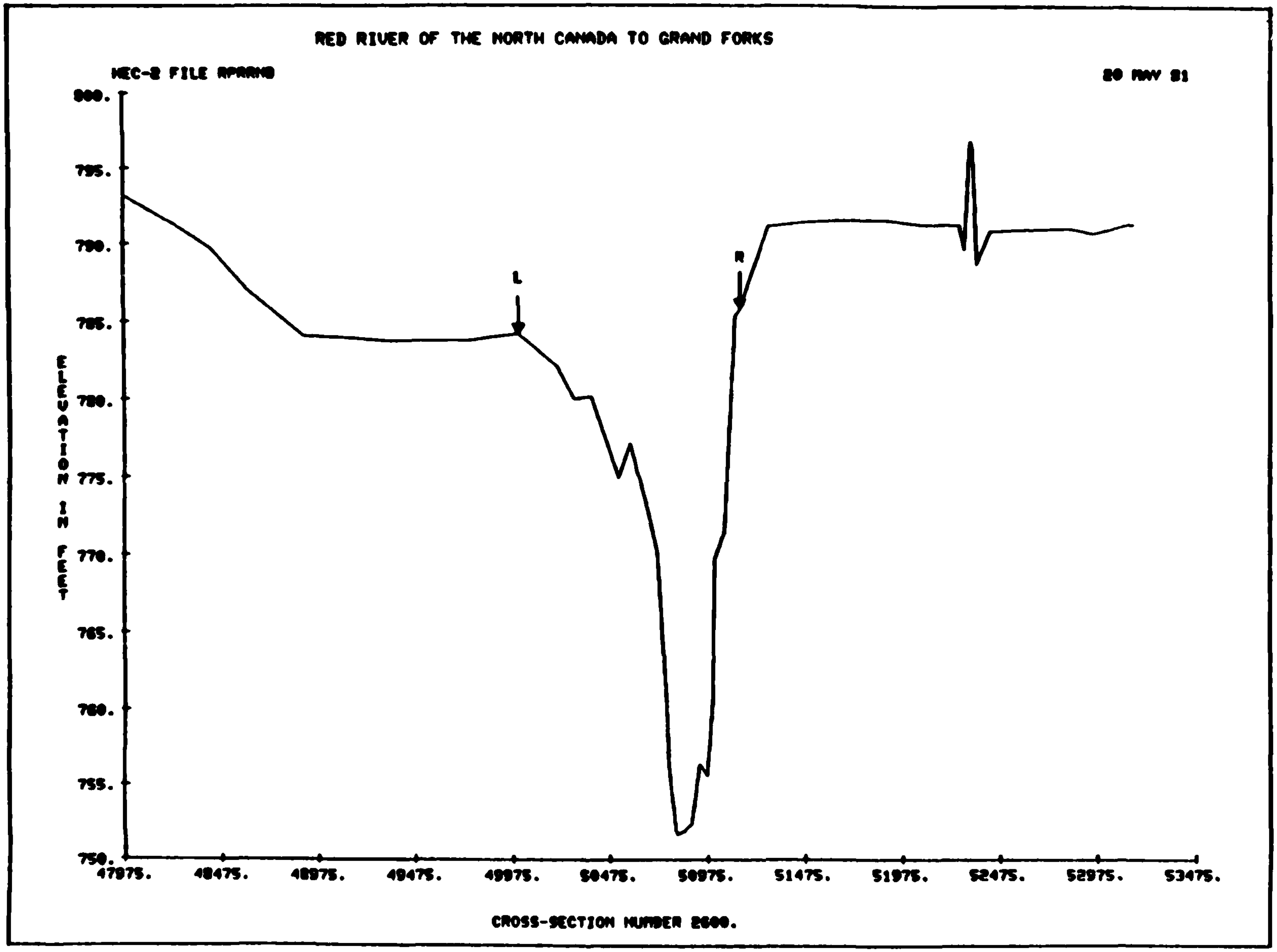
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ELEVATION IN FEET
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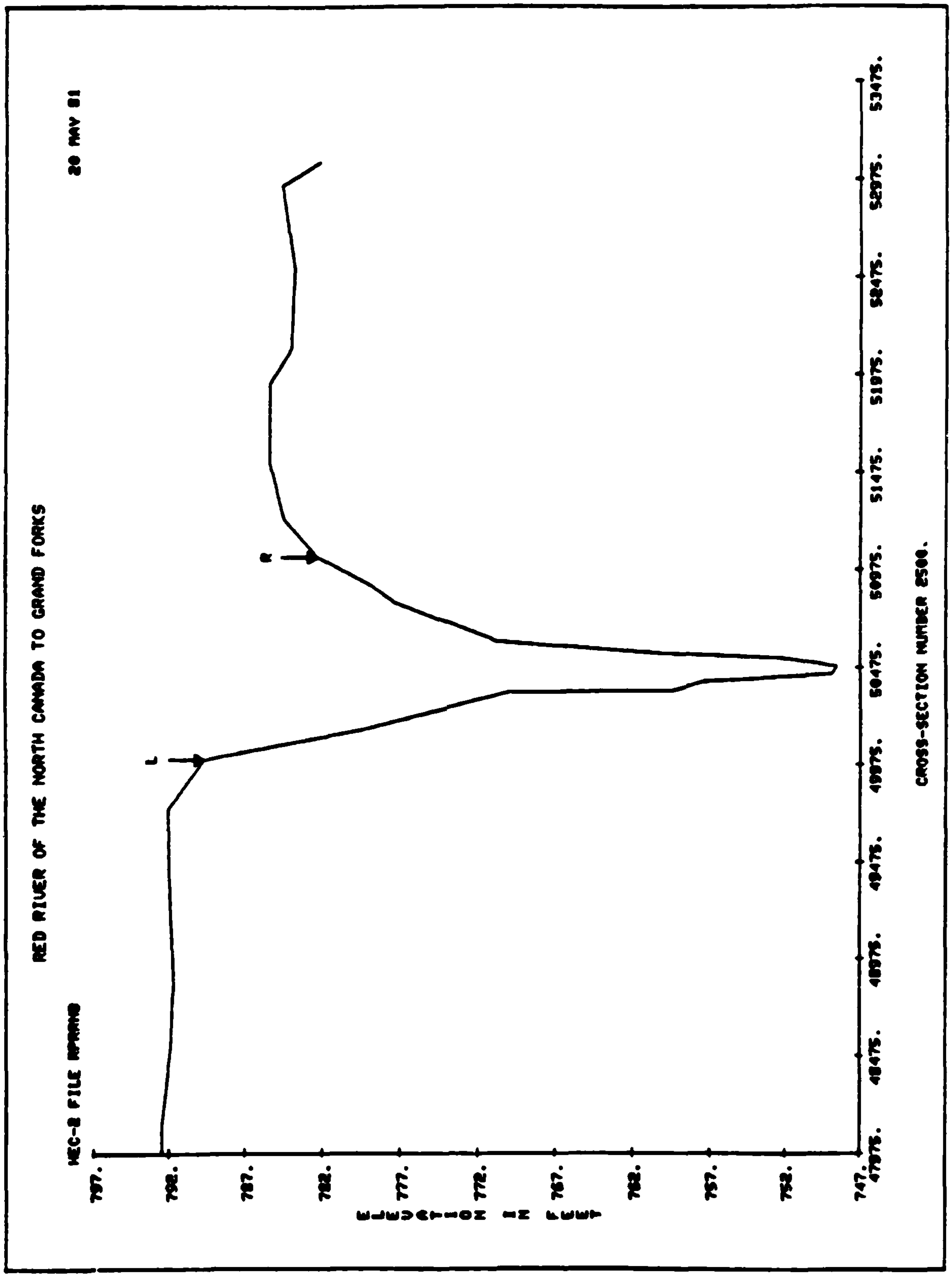

HEC-2 FILE
RED RIVER OF THE NORTH CANADA TO GRAND FORKS
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ELEVATION IN FEET
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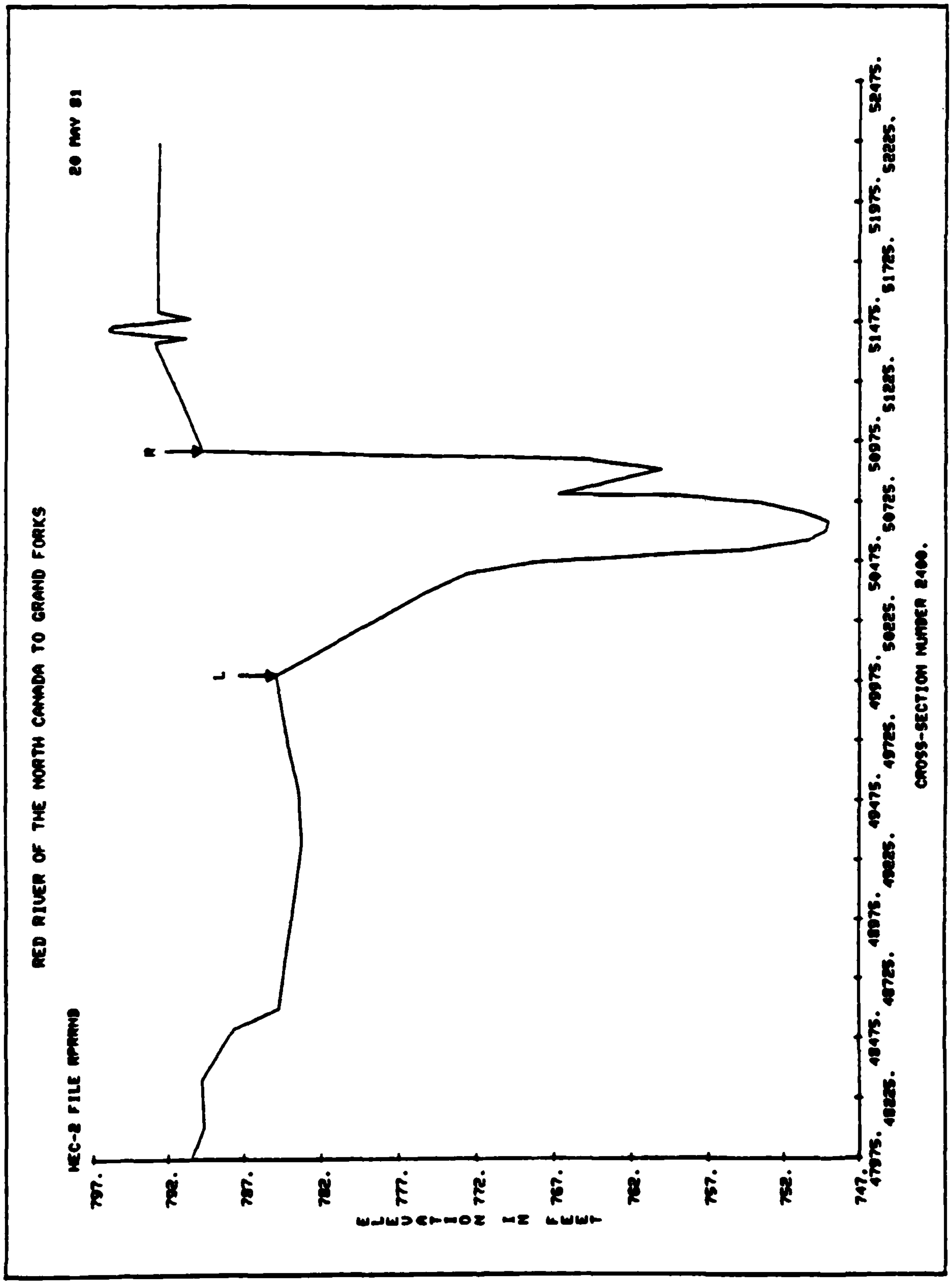
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ELEVATION IN FEET
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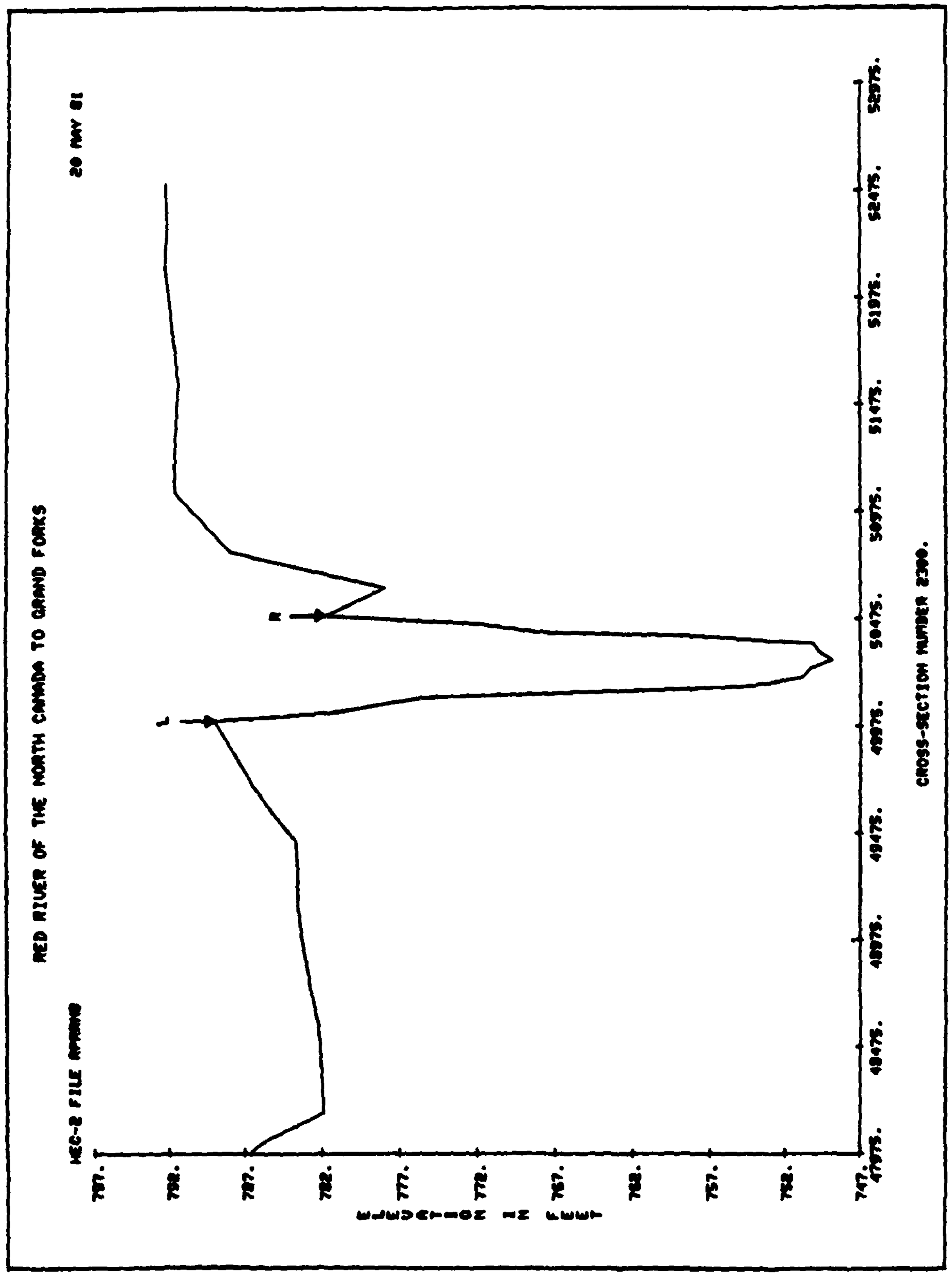
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HEC-2 FILE
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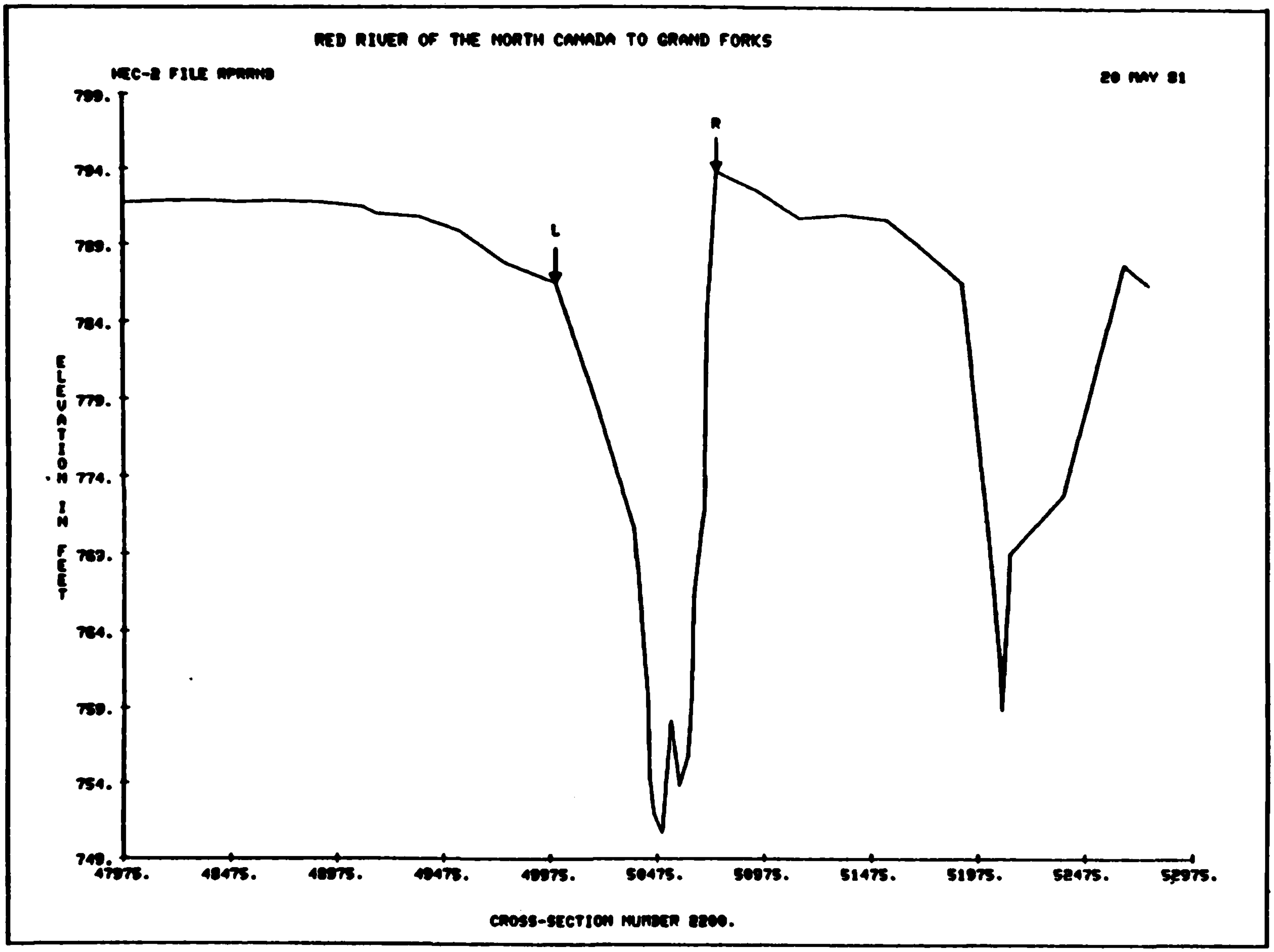
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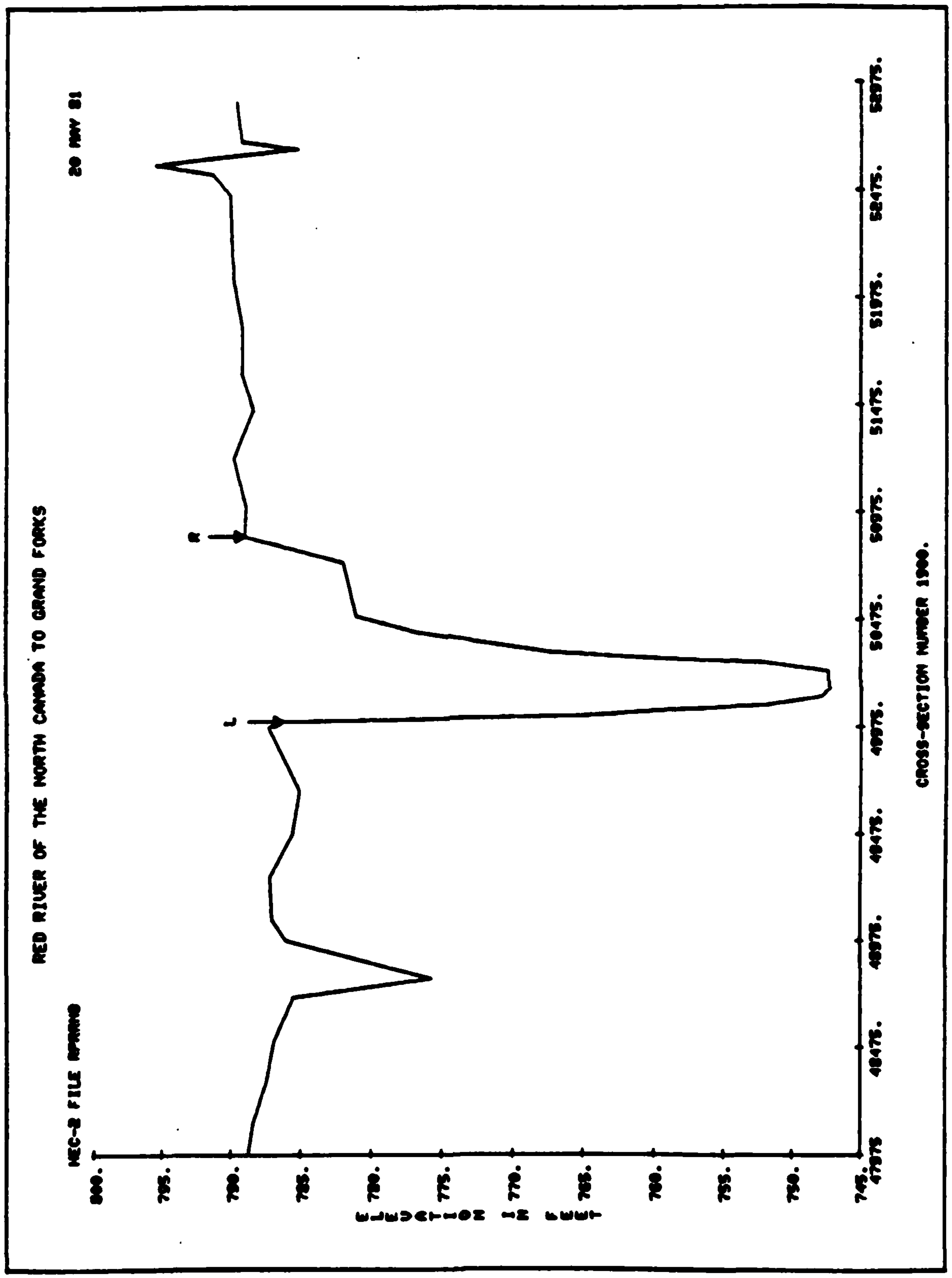
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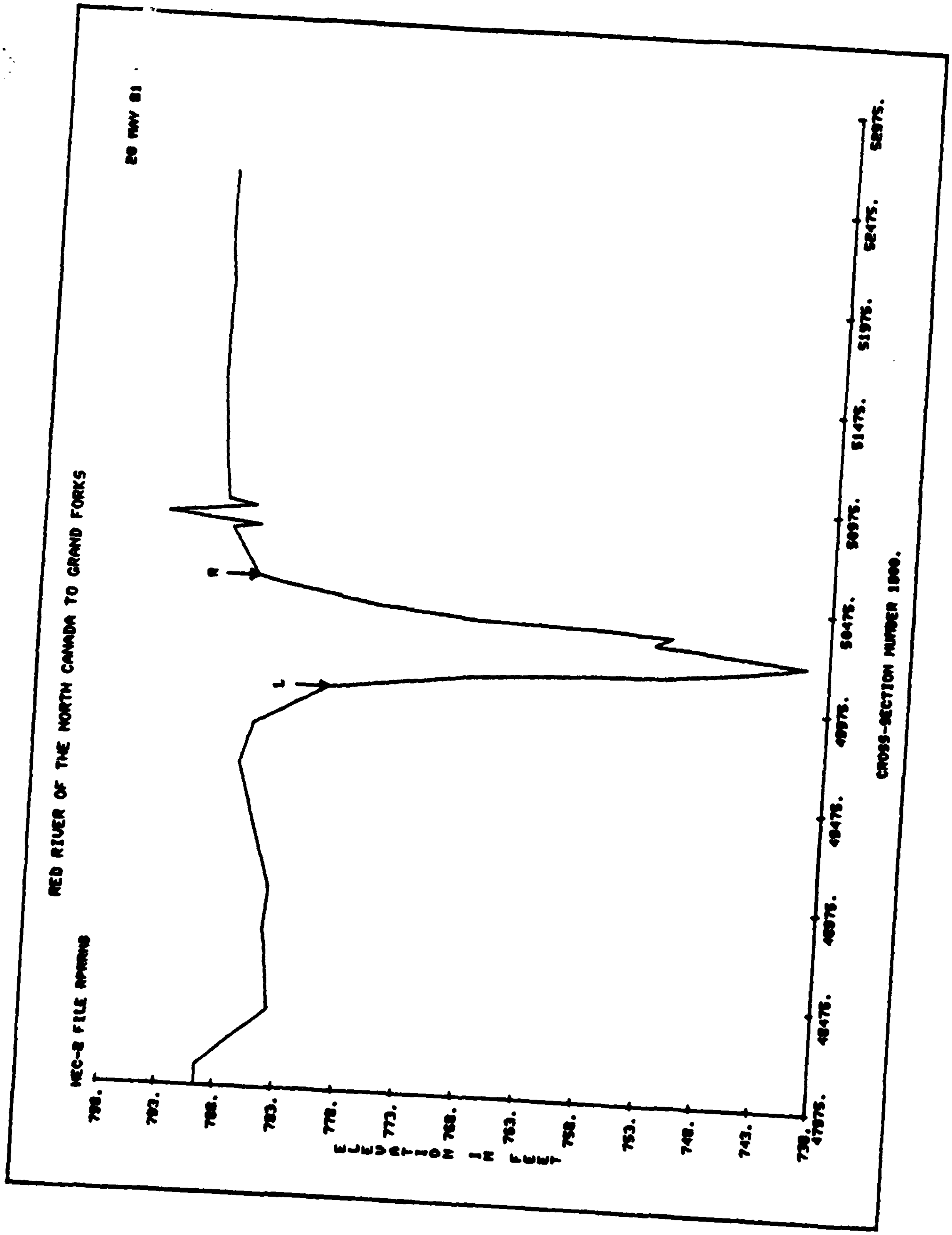

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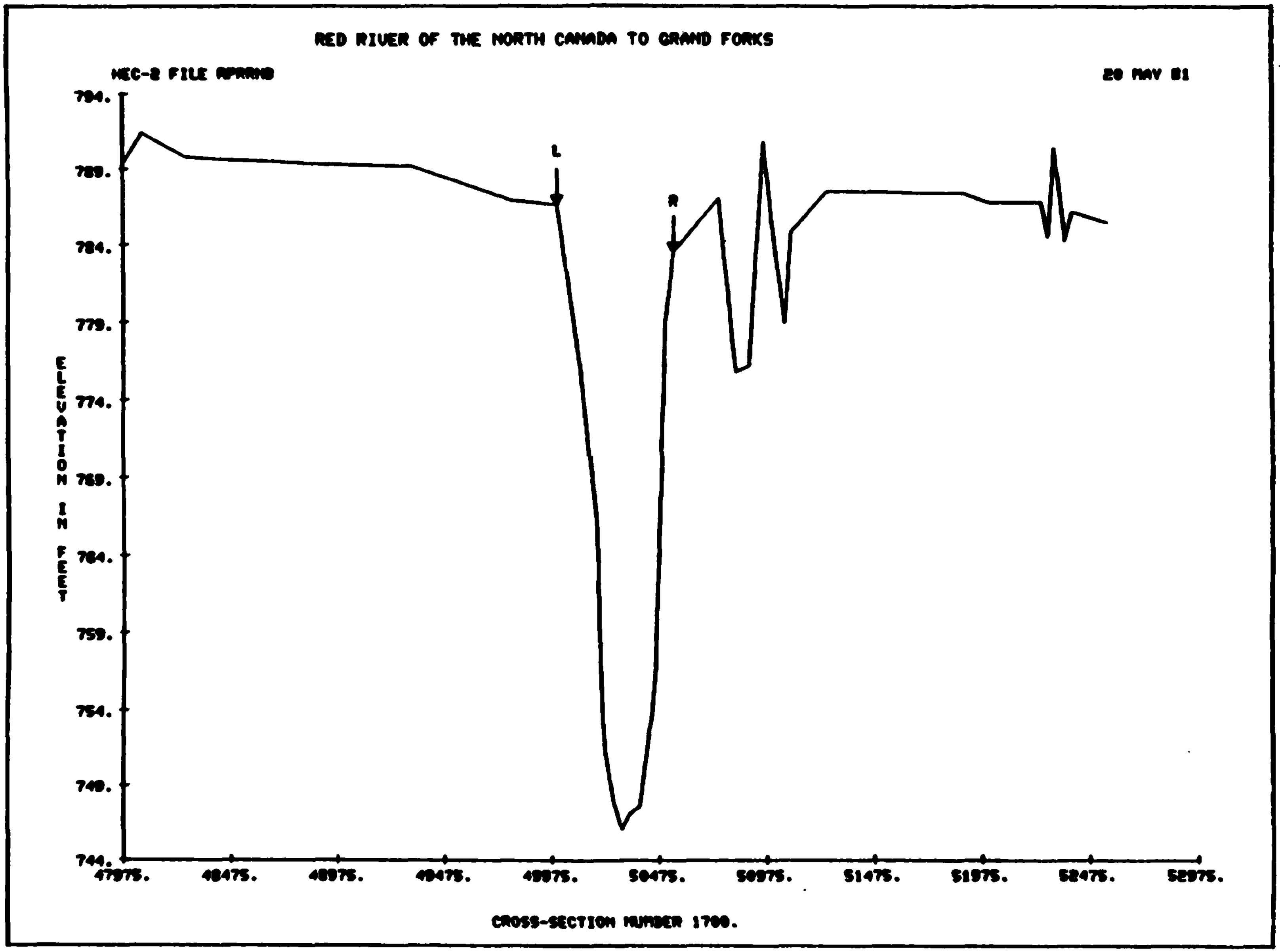

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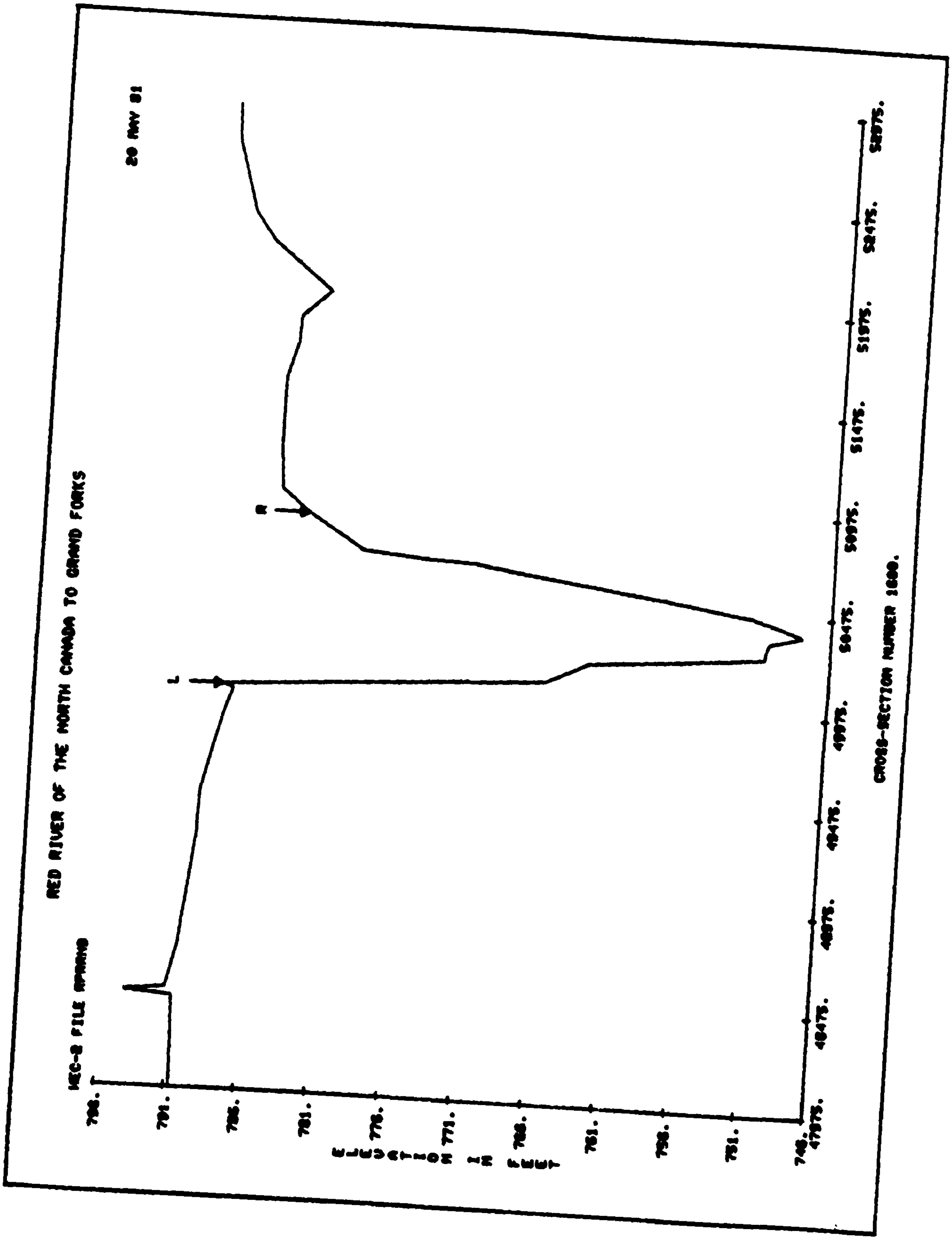
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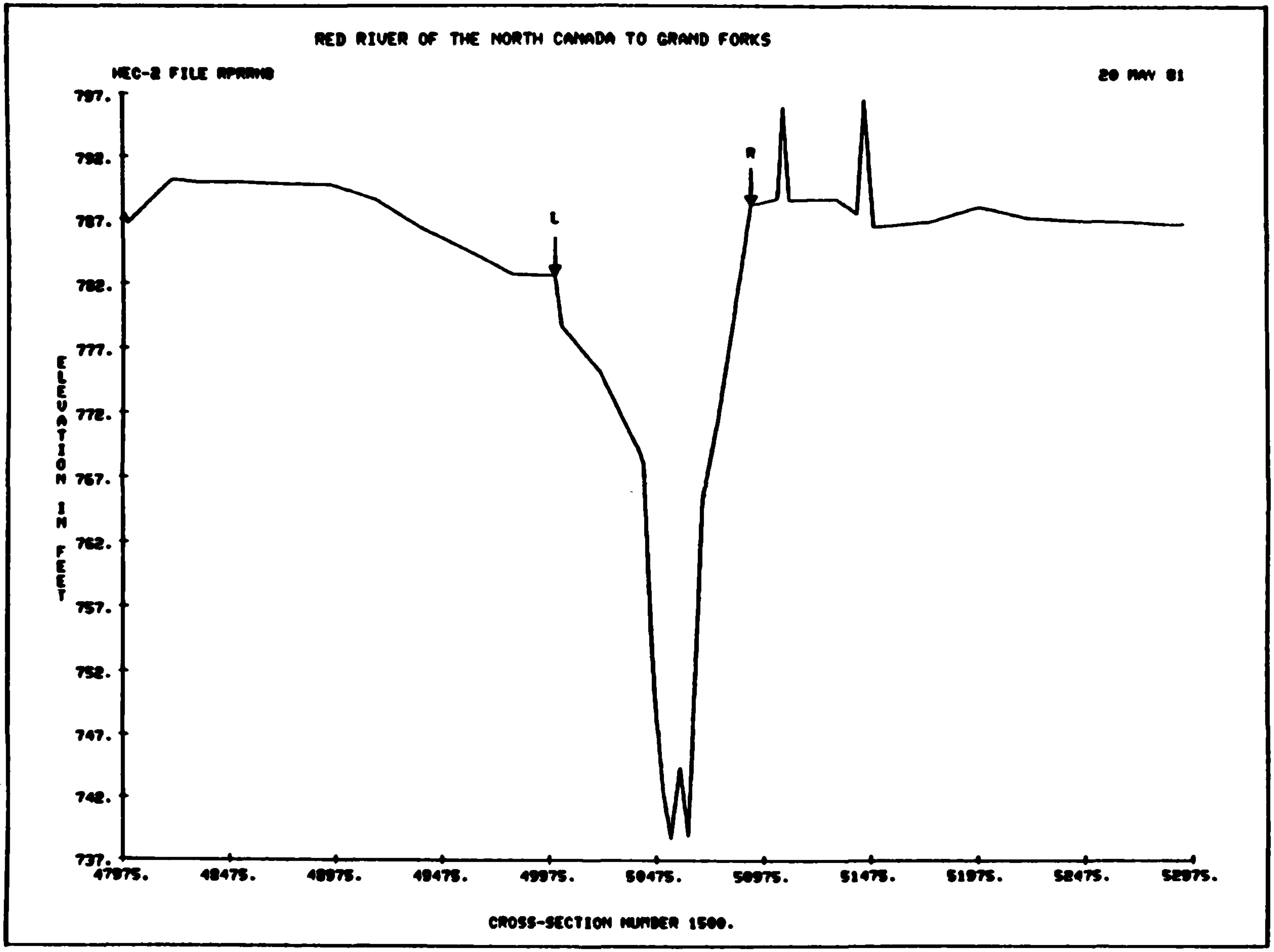
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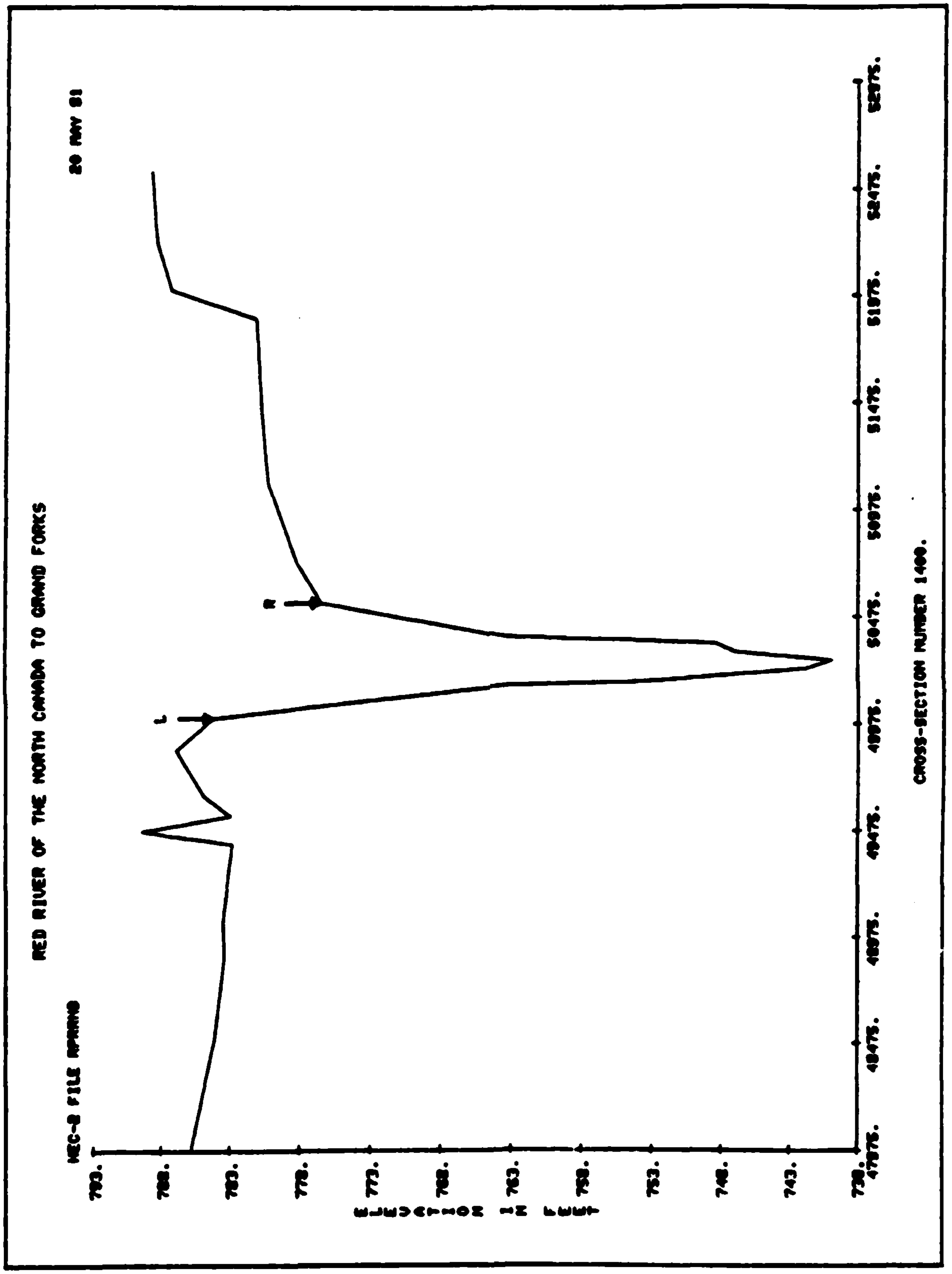
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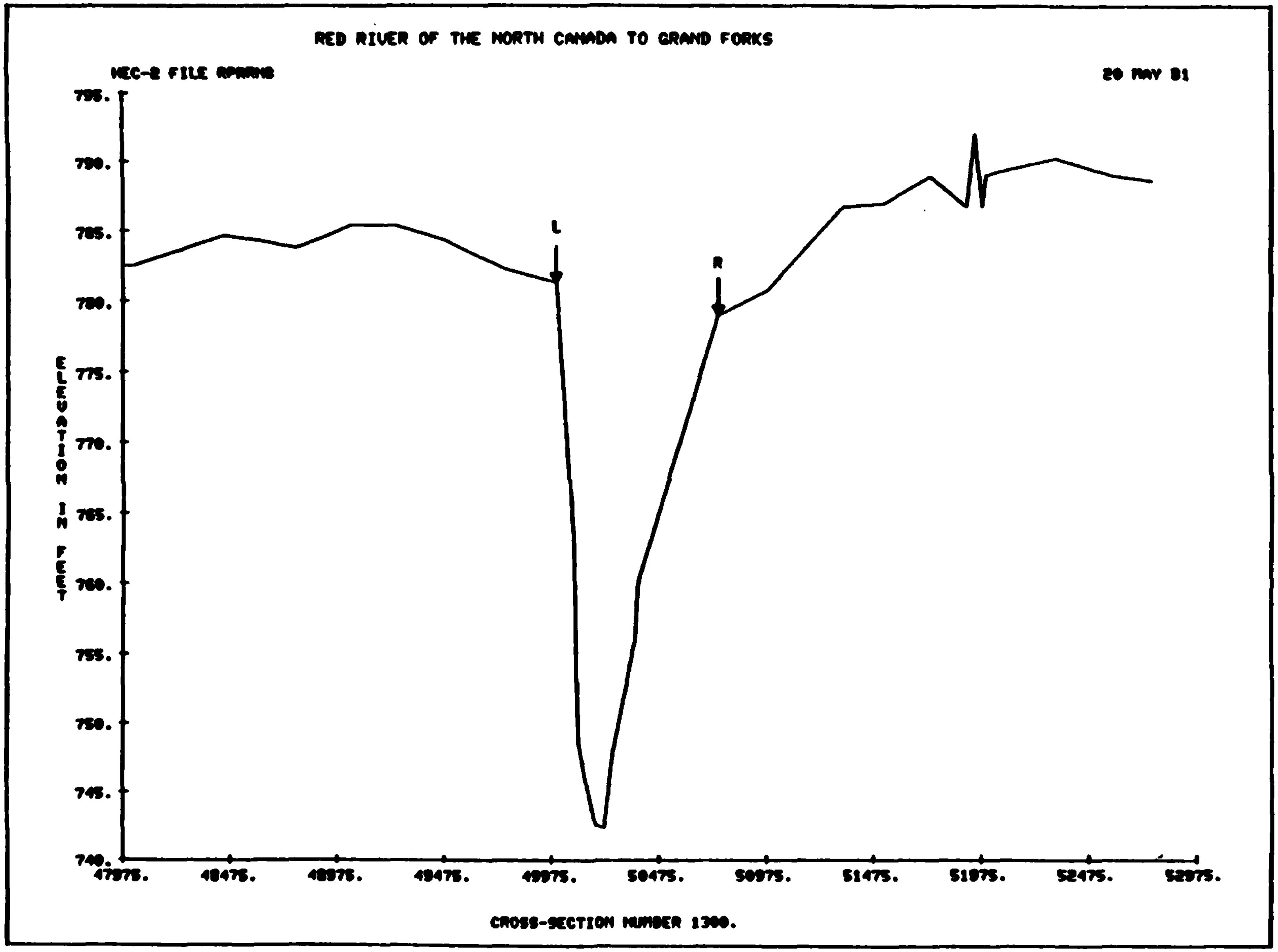
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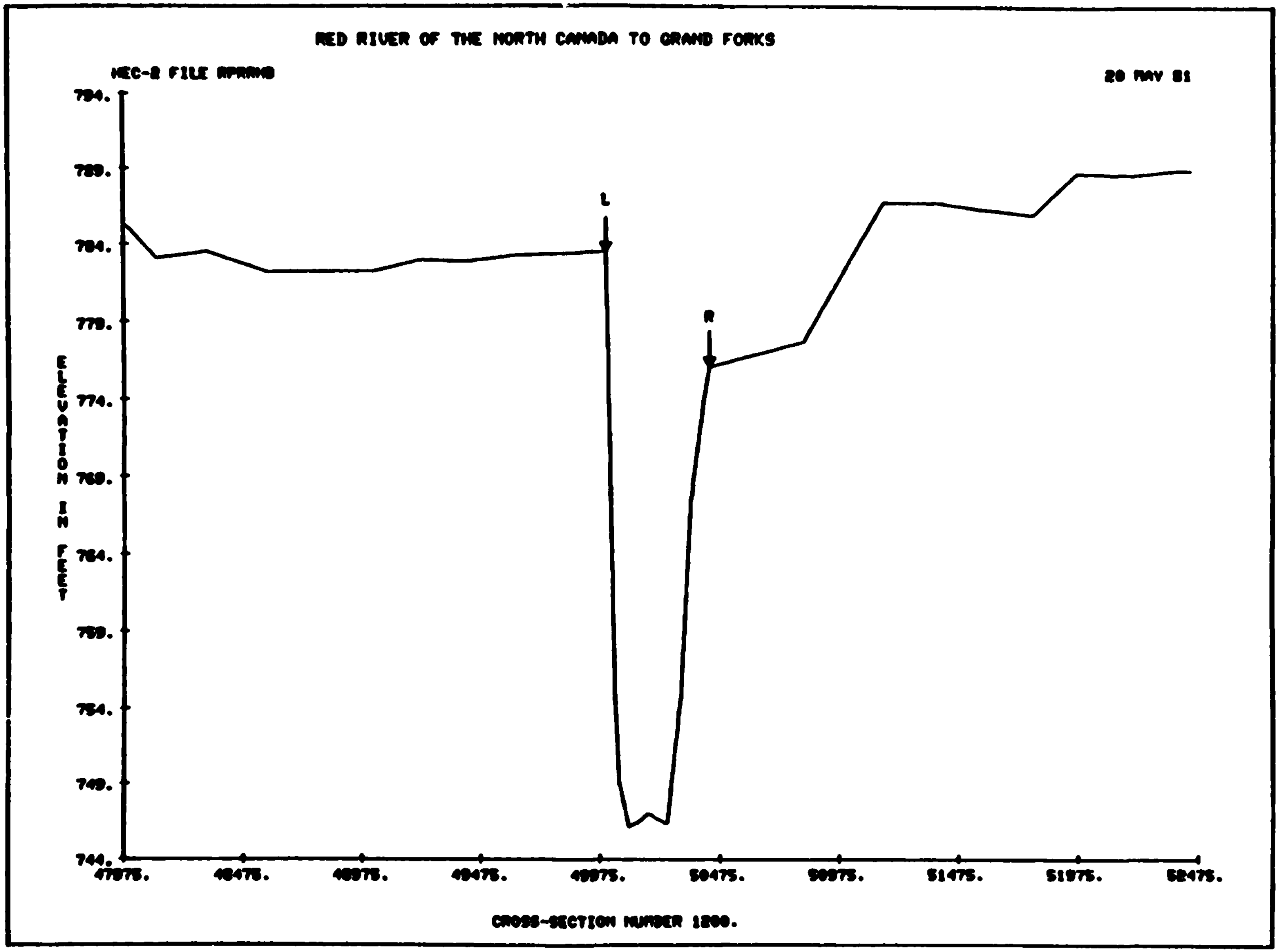
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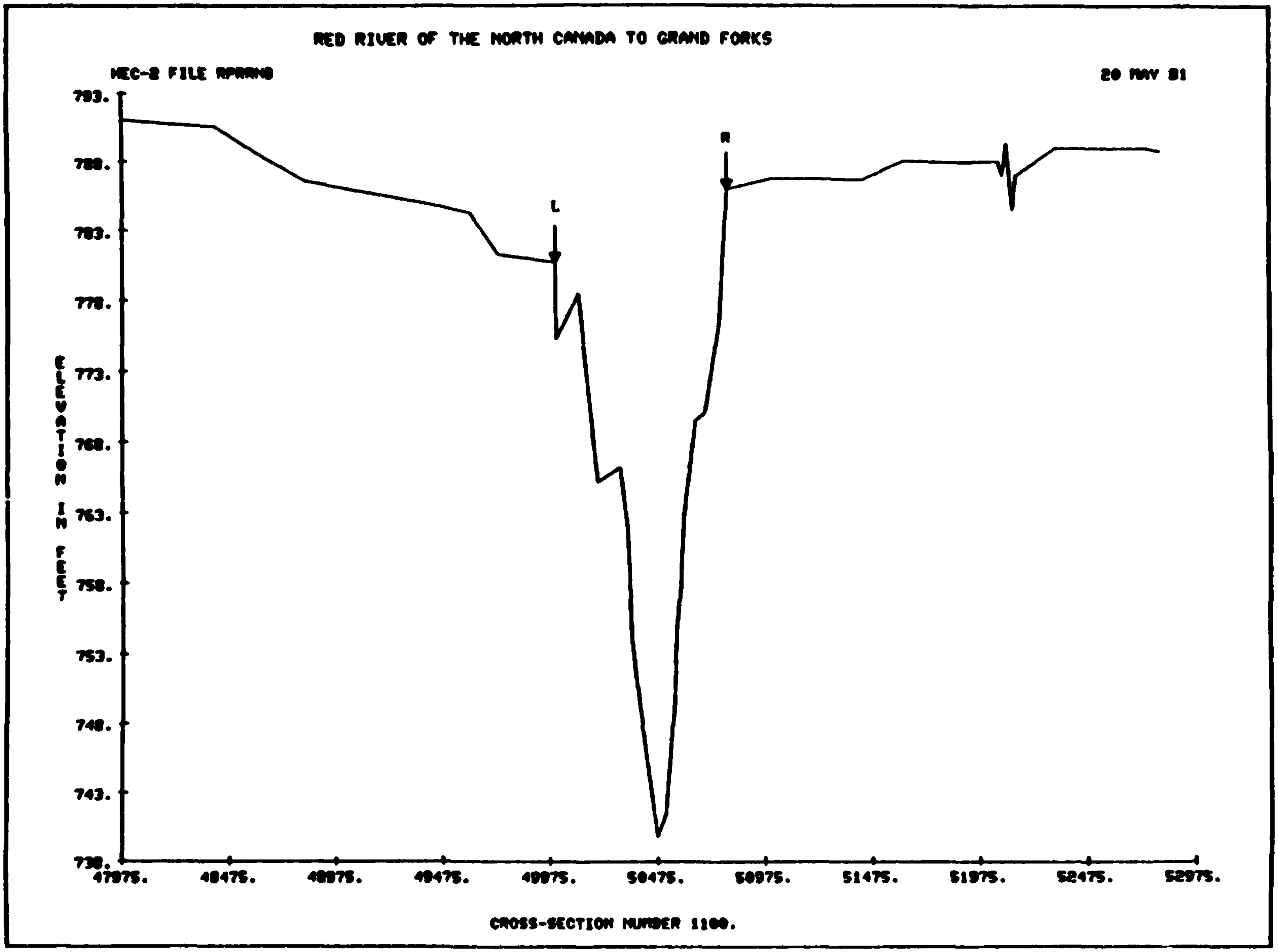
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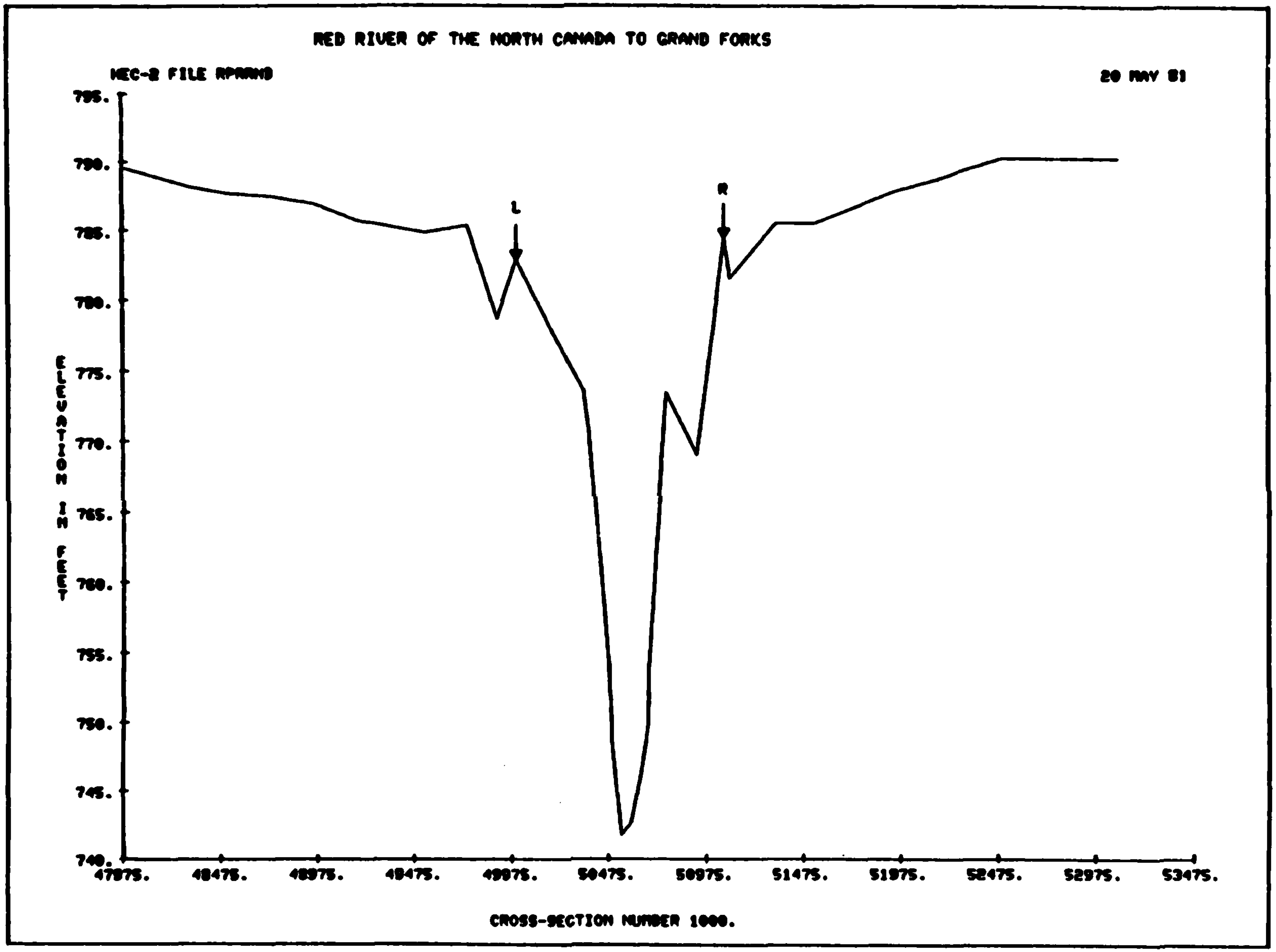
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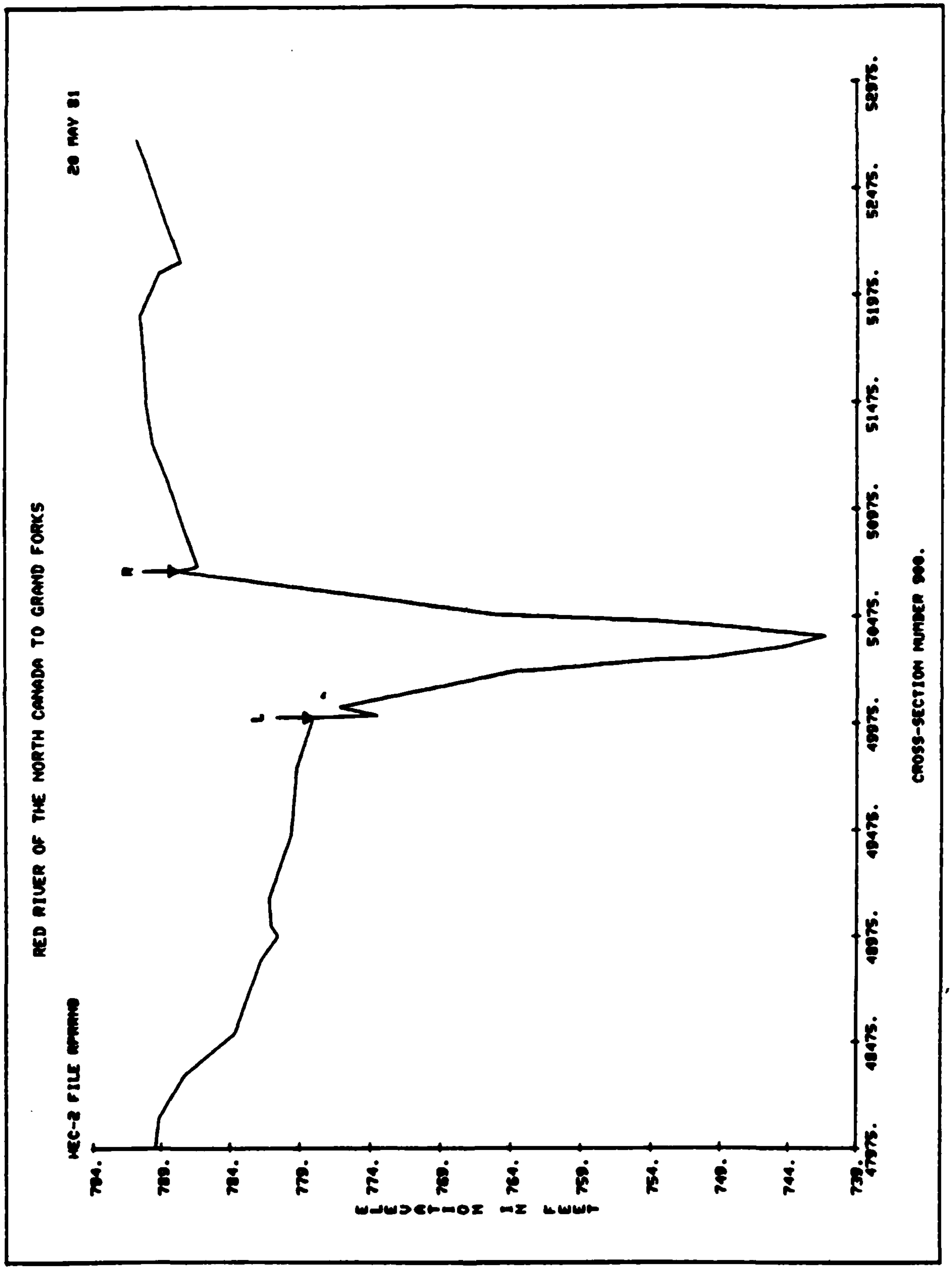

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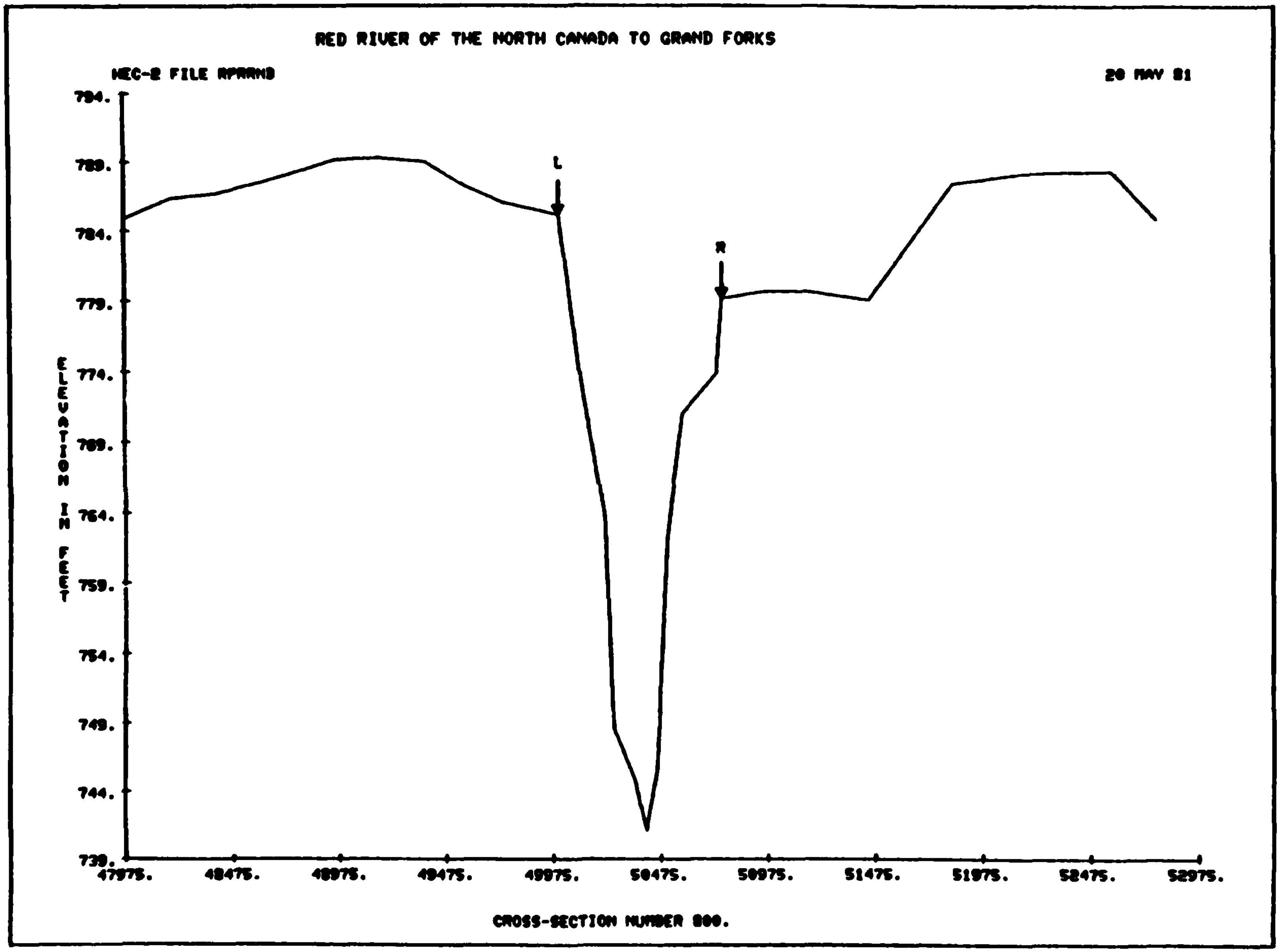

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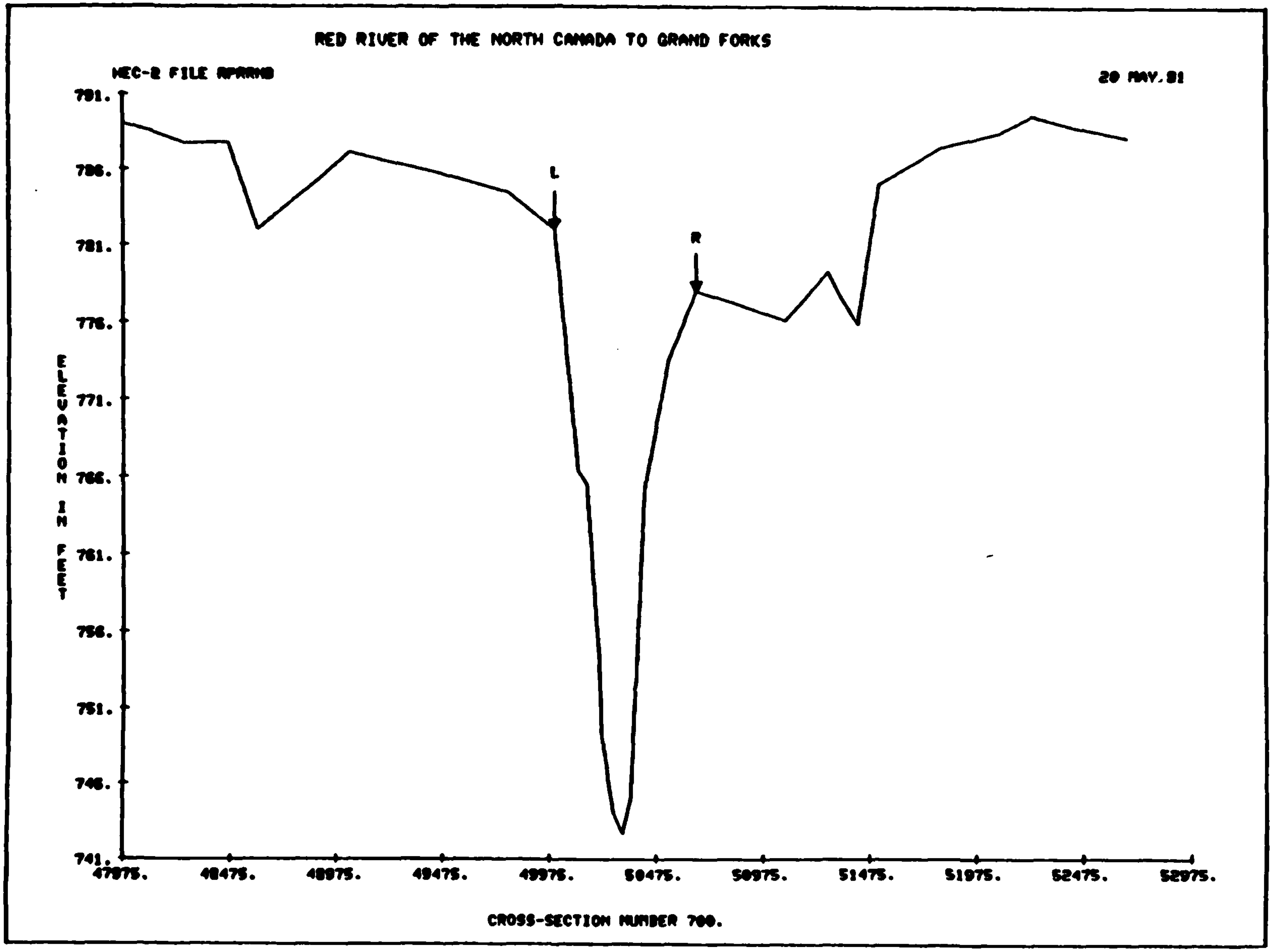
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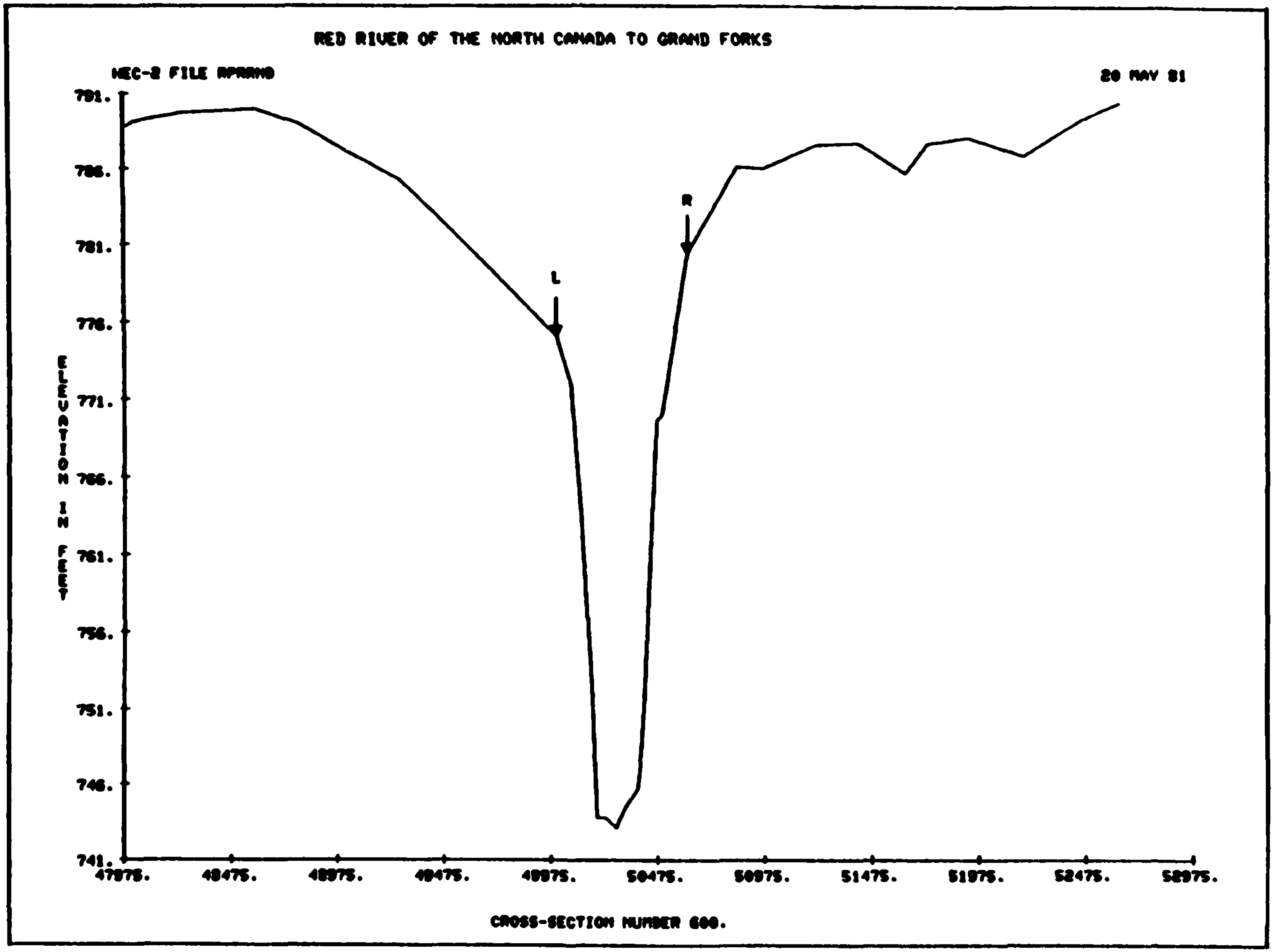

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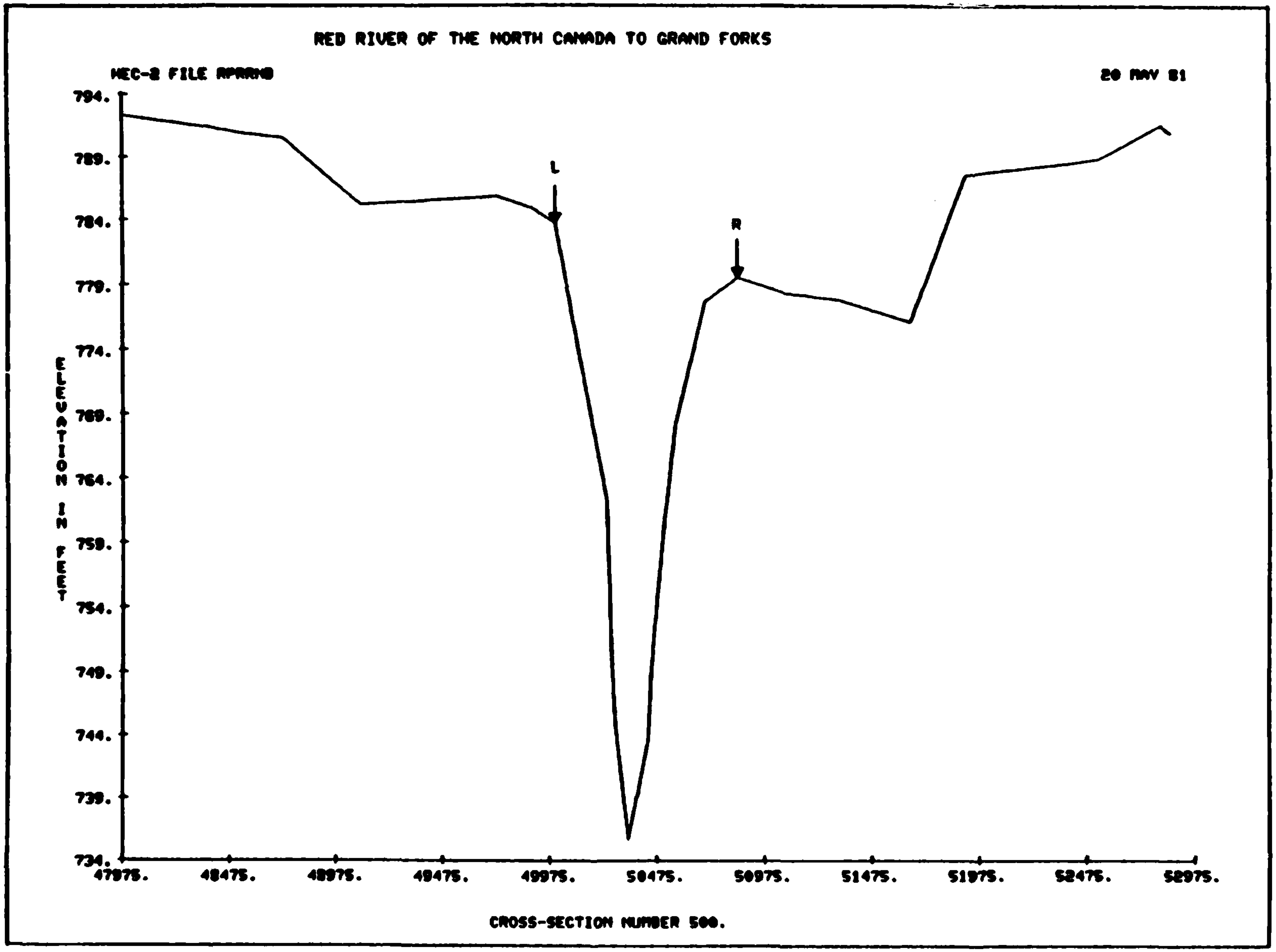
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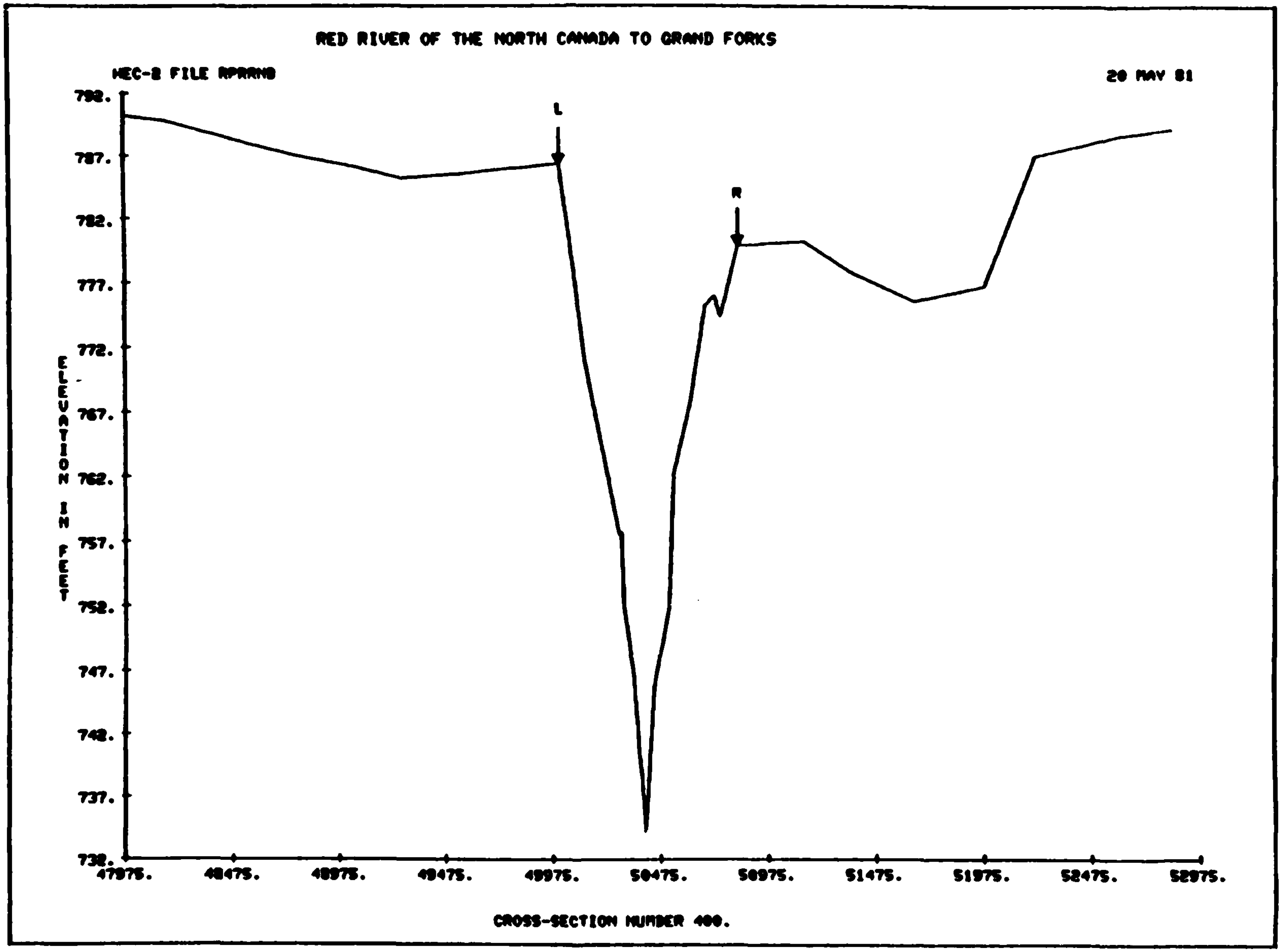
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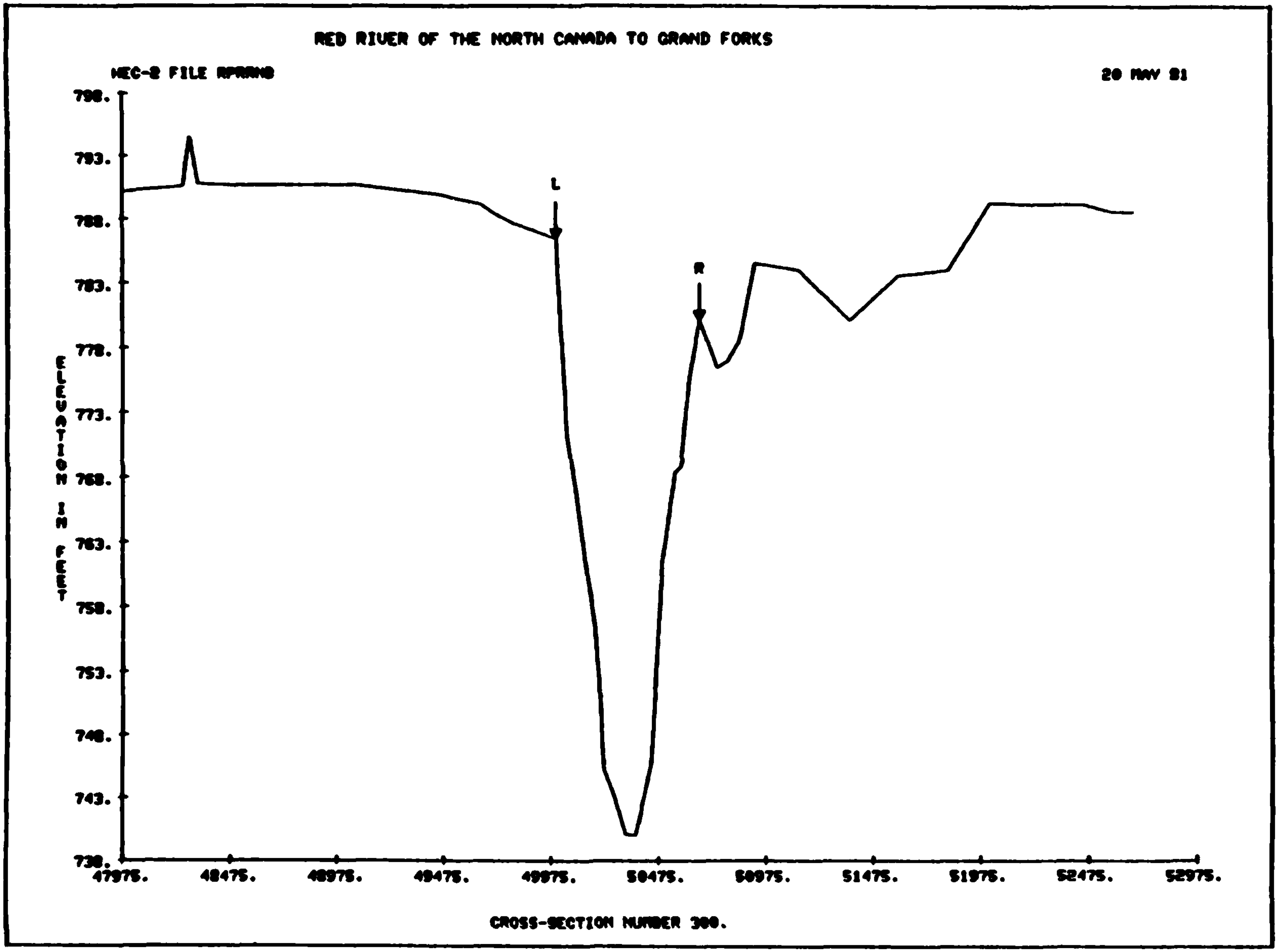
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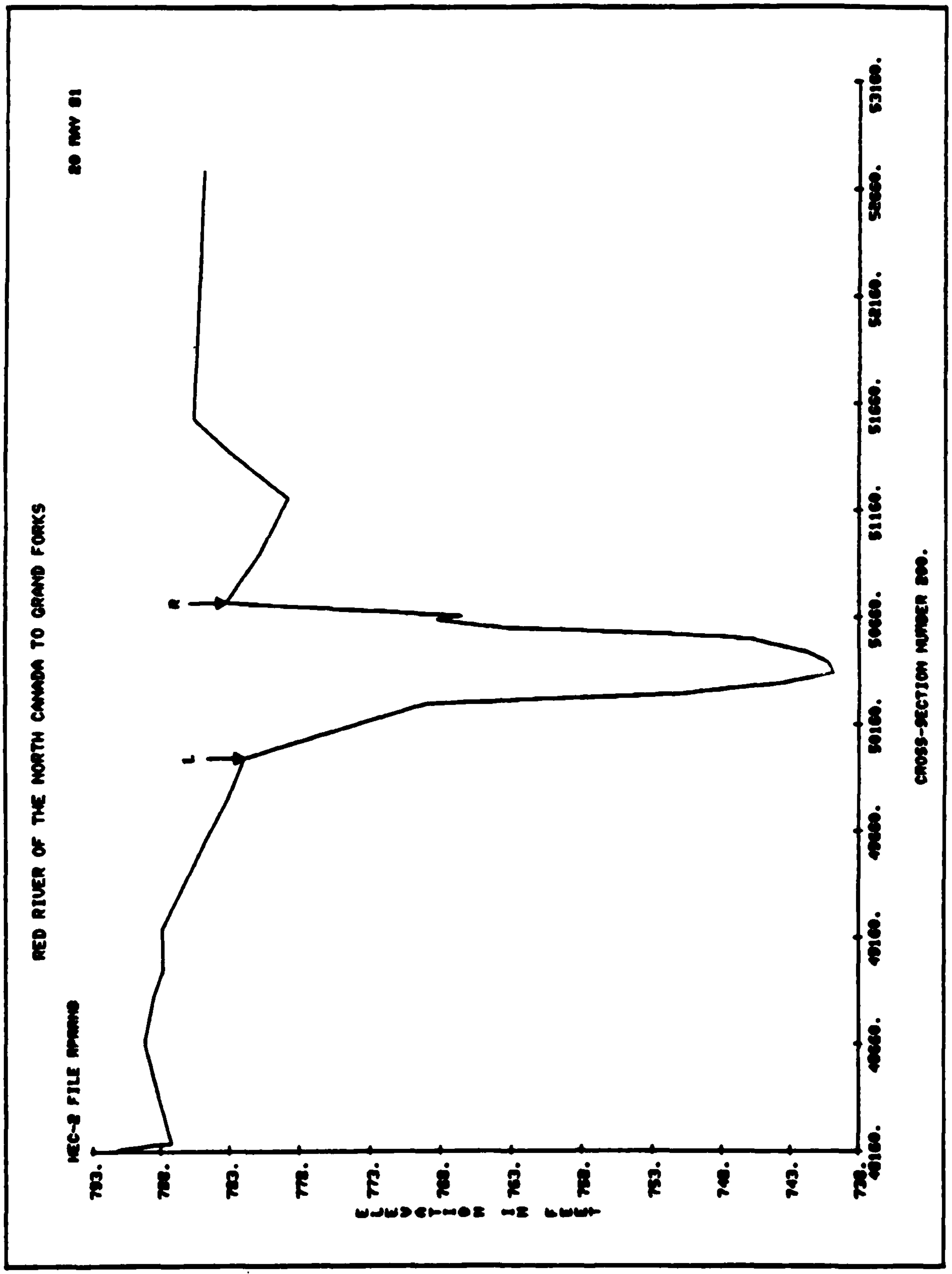
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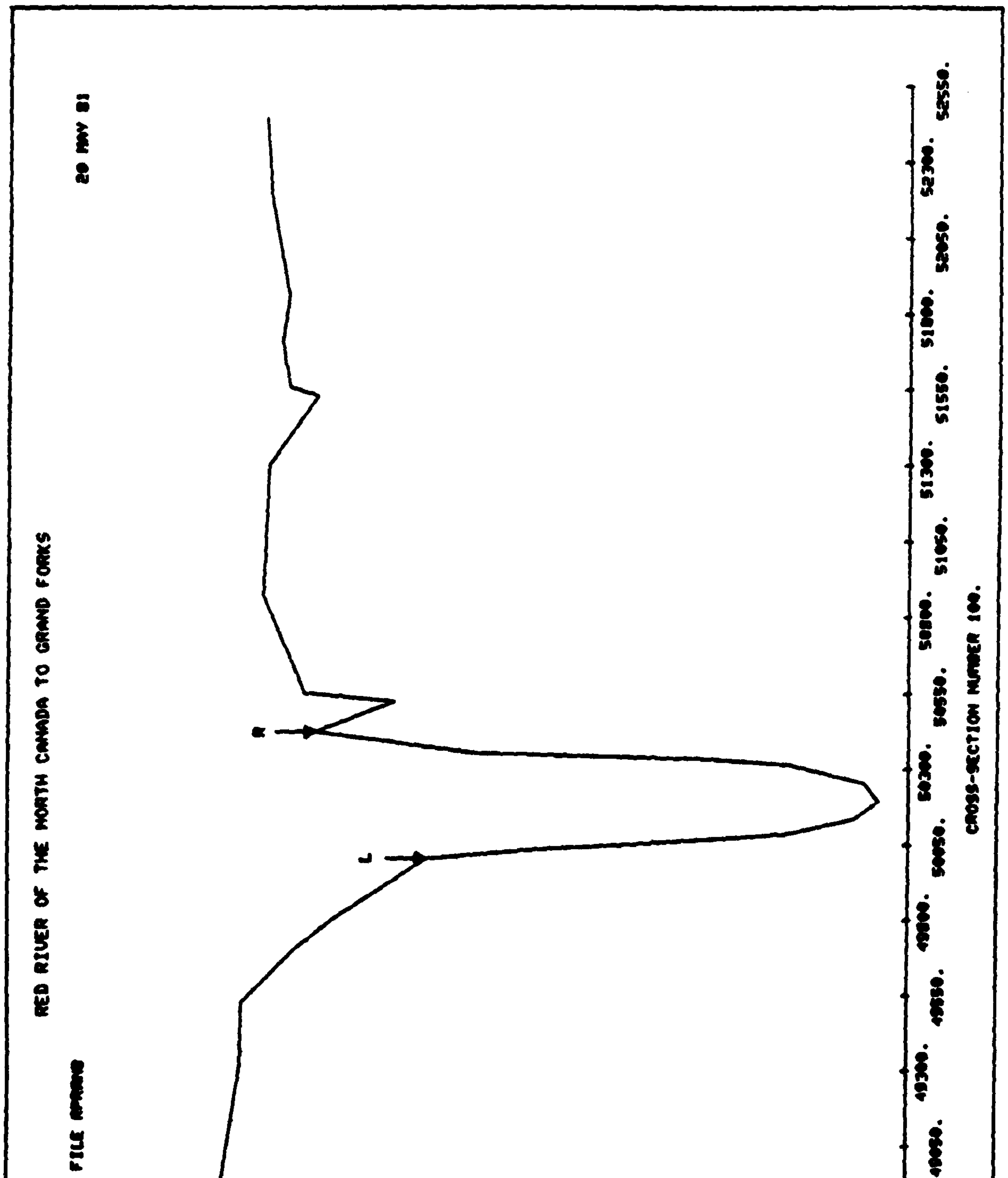
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APPENDIX D

CORRESPONDENCE

APPENDIX D
CORRESPONDENCE

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
[redacted]-NORTH DAKOTA
1500 CAPITOL AVENUE
BISMARCK, NORTH DAKOTA 58501

SEP 30 1983

Colonel Edward G. Rapp, District Engineer
St. Paul District, Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

Re: Farmstead Ring Levees
Reconnaissance Study
Pembina and Walsh Counties,
North Dakota

Dear Colonel Rapp:

This letter provides planning aid information for Items 1, 2, 3 and 4 of the Scope of Work for the U.S. Fish and Wildlife Service, FY 1983. Its purpose is to assist you in your study to determine the feasibility of developing ring levees around farmsteads to protect buildings, machinery and farmyards from frequent flood damages. The study area consists of the 100-year flood plain of the Red River of the North located in Pembina and Walsh Counties. Our planning aid input is in accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

PRELIMINARY PLAN OF DEVELOPMENT

In future studies, several alternatives will be addressed to determine which is best for the area. Alternatives to be considered include ring levees, raising of structures, evacuation and floodproofing. The only alternative addressed at this time, farmstead ring levees, was specifically selected by local interests.

For the purpose of this study, farmsteads have been divided into two categories: (1) those having no dikes or else having dikes unsuitable for improvement and, (2) those having dikes capable of being raised. About 60 percent of the farmsteads fall in the first category and 40 percent in the second. All ring levees would be constructed to a level 3 feet above the 100-year flood. Different levee heights would be required depending on where the farmsteads are located. Levees near the river would need to be higher than levees near the edge of the 100-year flood plain. A 10-acre levee enclosure is assumed to be the average size.

COVER TYPES/WILDLIFE RESOURCES

Farmsteads can be considered to represent a community complex that is composed of several distinct environmental niches that are interspersed within a relatively small plot of ground. Typical farmsteads include a house, barns, machine sheds, grain bins, feedlots, a lawn with ornamental trees and shrubs, occasionally a pond, and usually a windbreak or shelterbelt.

In the study area, from a cover type standpoint, farmsteads can be divided into two basic types: those located near the Red River with its native flood-plain forest, and those situated at some distance from the river entirely within agricultural land. Farmsteads located within or adjacent to the flood-plain forest would likely contain a variety of native trees, such as bur oak, green ash, boxelder, American elm, cottonwood, hackberry and basswood. Although the forest outside the farmsteads has a well developed understory, very few of these shrubs would be found in the farmsteads. The principal cover type of value to wildlife in the farmsteads located away from the river is the shelterbelt or windbreak. Some of the more common species of trees and shrubs planted in shelterbelts are Black Hills spruce, ponderosa pine, Rocky Mountain cedar, golden willow, American elm, Chinese elm, wild plum, caragana, boxelder, bullberry, Russian olive, lilac and green ash.

Characteristic breeding birds associated with farmsteads include the mourning dove, eastern and western kingbirds, barn swallow, house wren, brown thrasher, robin, starling, grackle, yellow warbler, house sparrow, rock dove and song sparrow.

Farmsteads near the Red River would have the same species plus several others characteristic of the flood-plain forest. These could include the Cooper's hawk, red-tailed hawk, great horned owl, downy woodpecker, hairy woodpecker, common flicker, bluejay, northern oriole, black-capped chickadee and white-brested nuthatch.

The principal upland game birds found near farmsteads would be ring-necked pheasants and gray partridges. Mallards, blue-winged teal and other puddle ducks could be expected to rest on some farmstead ponds.

White-tailed deer frequent the Red River bottoms and shelterbelts. They are more numerous on farmsteads near the river. Small mammals occuring around farmsteads include fox squirrels, cottontails, several species of mice, voles and shrews.

GENERAL ANALYSIS OF DIRECT AND INDIRECT EFFECTS OF RING LEVEES ON WILDLIFE

According to a preliminary evaluation of farmsteads in the study area by the Corps of Engineers, about 89 percent of the farmsteads had some type of wooded area, usually in the form of a planted windbreak. Grasslands, present on about 88 percent of the farmsteads, were either heavily grazed or residential sites. About 8 percent of the farmsteads has wetlands; all less than 1 acre. Most of the wetlands were stock or farm ponds. Ring levee construction would destroy some trees on 35 percent of the sites evaluated.

The greatest potential impact of farmstead ring levee construction would be the loss of trees. While all woodlands are valuable to wildlife, the riparian woodlands are much more diverse and support a much greater variety of wildlife species than shelterbelt woodlands. Consequently, the loss of the flood-plain forest would be of greater significance than the loss of shelterbelt trees. In either case, there would be a loss of wildlife numbers proportionate to the amount of trees cleared. It cannot be assumed that the wildlife displaced would move to nearby shelterbelts or riparian timber. Generally, these habitats are already fully occupied.

Due to the nature of the grasslands associated with farmsteads in the study area, the impact of constructing ring levees through this type of habitat should not have a significant effect on wildlife resources. The establishment of permanent grass and herbaceous vegetation on the levees should result in enhancement to the quality of grass cover and to the wildlife species dependent upon it.

Since so few of the farmsteads have wetlands and those generally are stockponds, ring levee construction should have little impact on wetlands. Most of the stockponds would probably be enclosed by the levees. If there are any oxbow wetlands that would be impacted by ring levees, the effect could be locally severe to the several species of aquatic birds and mammals that use this type of wetland. Species that could be affected by construction through oxbows include wood ducks, mink and muskrats.

SUGGESTIONS FOR MODIFICATION OF PROJECT PLANS TO AVOID OR MINIMIZE ADVERSE IMPACTS AND MEANS TO PRESERVE ENVIRONMENTAL QUALITY

Items 2 and 3 of the Scope of Work are so similar they are combined here.

Many farm owners will want to preserve the trees on their farmsteads, especially in those farmsteads where windbreak protection is minimal. In such cases, every effort should be made to include the entire windbreak in the ring levee. In other cases, it may be possible to modify a ring levee to exclude a windbreak, rather than cut through it. Since the windbreaks were planted by the landowners, loss of a portion of one as a result of levee construction will have to be a private decision. In such cases, the landowner should be encouraged to plant trees outside the ring levees to restore windbreak protection for the farmstead, restore wildlife habitat and to provide protection of the levees from wave action. In fact, we would like to see the specifications for ring levees include a requirement for tree and shrub planting outside all the ring levees for the purposes listed above. At those farmsteads where there is no tree loss, the planting would be entirely enhancement.

In the case of ring levees around farmsteads located near the river in good riparian woodlands, avoidance of trees will be impossible. This is especially true since levees in these locations would have to be higher and wider than those farther from the stream. Perhaps floodproofing or evacuation should be considered for some of these farmsteads. Ring levees in these locations would be more expensive and would cause more environmental damage. If ring levees are built in locations that cause significant loss of riparian woodland, sufficient tree planting to compensate for the loss should be mandatory.

Similarly, every effort should be made to avoid impacting oxbow wetlands, and if not possible, the loss should be compensated. This could be accomplished by development of wetlands in borrow areas. Development of wetlands in borrow areas around farmsteads where no wetlands are present or adversely affected would be a desirable enhancement measure.

The Corps of Engineers should coordinate with the North Dakota Game and Fish Department, U.S. Soil Conservation Service and the U.S. Fish and Wildlife Service about planting rates, species and maintenance recommendations for establishment of grass and herbaceous cover on levees, and establishment of tree plantings outside the levees.

DATA DEFICIENCIES AND STUDIES REQUIRED TO CORRECT DEFICIENCIES

The preliminary studies conducted by the Corps to identify the types of vegetation that would be impacted by construction of ring levees covered only a portion of the farmsteads in the study area. This study should be updated and expanded to include the entire study area. Special effort should be made to quantify the acreage of woodland that would be affected and to separate the woodland losses into windbreak and riparian woodland categories. The results of this study would identify the magnitude and significance of the woodland loss. An effort should also be made to quantify potential wetland losses, particularly natural wetlands, if any.

We believe the above studies would provide the means to evaluate the overall effects of the proposed ring levees on the natural resources of the area.

The U.S. Fish and Wildlife Service's Mitigation Policy (Federal Register; January 23, 1981) is used by the Service in the evaluation of impacts to land and water developments and in the subsequent recommendations to mitigate adverse impacts. The policy establishes four Resources Categories, Designation Criteria and Mitigation Planning Goals for cover types to be impacted by a project. These are described below:

Resources Category	Designation Criteria	Mitigation Planning Goal
1	High value of evaluation* species and unique and irreplaceable on a national basis or in ecoregion basis.	No loss of existing habitat value. FWS will recommend that losses be prevented.
2	High value for evaluation species and scarce or becoming scarce on a national basis or an ecoregion section.	No net loss of in-kind habitat value. Losses are to be compensated by replacement of the same kind of habitat.
3	High to medium value for evaluation species and is relatively abundant on a national basis.	No net loss habitat value while minimizing loss of in-kind habitat value.

Resource Category	Designation Criteria	Mitigation Planning Goal
4	Medium to low value for evaluation species.	Minimize loss of habitat value.

*Fish and wildlife species that are representative of the cover types occurring in a project area and which reflect the projected habitat changes, both positive and negative, that result from project development.

The cover types of concern in the study area have been identified as woodlands and oxbow wetlands. Riparian woodlands and oxbow wetlands would fall in Resource Category 2 while shelterbelt woodlands are in Resource Category 3.

We hope this information will assist you in your planning efforts for the Farmstead Ring Levee Study. If you have any questions, please contact Don Simpson (FTS: 783-4485).

Sincerely,

M. S. Zschomler

M. S. Zschomler
Field Supervisor-Habitat Resources

APPENDIX E

NATURAL DISASTER EMERGENCY OPERATIONS PLAN
FOR PEMBINA AND WALSH COUNTIES

PART 1 - PEMBINA COUNTY

PART 2 - WALSH COUNTY

APPENDIX E

PART 1

PEMBINA COUNTY NATURAL DISASTER
EMERGENCY OPERATIONS PLAN

PEMBINA COUNTY

NATURAL DISASTER EMERGENCY OPERATIONS PLAN

THE BASIC DOCUMENT

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AUTHORITIES

North Dakota Century Code, Chapter 37-17.1, as amended

Pembina County Resolution, dated November 6, 1973.

PURPOSE

The Purpose of this plan is to:

1. Provide a coordinated effort for saving lives and protecting property in the event of a natural disaster.

2. Support city government within Pembina County in their efforts to save lives and protect property during a natural disaster emergency.

3. Define the responsibilities of agencies and departments of county government in preparation for, response to, and recovery from a natural disaster emergency.

ASSUMPTIONS

A disaster emergency is not a situation dealt with in the daily activities of Pembina County government. A disaster emergency is the occurrence or imminent threat of widespread or severe property damage, injury or loss of life resulting from any natural or man-made cause.

The greater hazards to Pembina County are tornadoes, winter storsm, floods, hazardous materials, and structural fires.

State and federal assistance is a supplement to, but not a substitute for, Pembina County disaster emergency efforts.

CONCEPT OF OPERATIONS

This plan is in effect when a disaster emergency is declared by the Board of County Commissioners or when a disaster emergency occurs or is imminent in Pembina County. It is the responsibility of county government to respond to disaster emergency situations in all areas of the county. County government recognizes established jurisdictions (i.e., cities). This plan in no way supercedes the responsibility of these jurisdictions to respond to and recover from disaster emergency situations affecting their constituents, but will support these jurisdictions upon request.

The Pembina County Commission has the overall responsibility for control of county government operations to save lives and protect property.

The Pembina County Disaster Emergency Services Coordinator is responsible for coordinating all emergency operations of county government.

All agencies/individuals assigned by this plan are responsible for:

1. Providing equipment and other administrative needs to perform their assigned emergency function.

2. Maintaining necessary records, especially financial, to support their assigned emergency function.

3. Supervising the functions for which they are responsible.

4. Supporting the next higher or lower echelons of government.

5. Developing reference materials; such as, narrative procedures, checklists or lists of equipment and personnel; relating how to accomplish tasks.

Disaster emergency operations will be directed from the Pembina County Emergency Operations Center located at the Pembina County Courthouse. When this plan is put into effect, the Emergency Operations Center will be activated and individuals having the primary responsibility for each of the following emergency functions will relocate to the EOC to direct response operations:

Coordination and Control. . . . . . County Commission

Administration. . . . . County Auditor

Warning . . . . County Sheriff

Communications.	County Sheriff
Public Works and Engineering. . . .	County Road Superintendent
Damage Assessment	Tax Equalization Director/ County Road Superintendent
Health and Medical.	County Health Officer
Public Safety	County Sheriff
Individual and Family Assistance. .	Social Services Director

Disaster Emergency Operations will be conducted in two phases:

1. Response to the disaster: When a disaster emergency is imminent or occurs, the main response of Pembina County is to save lives and protect property. When Pembina County officials determine that response to the disaster emergency situation is warranted, they will activate this plan. Agencies/departments of county government who have a response function will perform tasks as outlined under their assigned functions until such time that there is no longer any threat to lives and property.

2. Recovery from the disaster: Once the threat of the disaster emergency situation has passed, saving lives and protecting property is no longer the prime consideration. Agencies/departments of county government who have a recovery function will perform tasks as outlined under their assigned function until the County Commission determines that normal day-to-day government operations can resume.

The relationship between the departments of county government and the functional areas is portrayed on the Department/Function Chart on the following page.

PEMBINA COUNTY

DEPARTMENT/FUNCTION CHART

P - PRIMARY RESPONSIBILITY

S - SUPPORT RESPONSIBILITY

DEPARTMENT / EMERGENCY FUNCTION	Coordination and Control	Administration	Warning	Communications	Public Works and Engineering	Damage Assessment	Health/Medical	Public Safety	Individual & Family Assistance		
County Commissioners	P										
County Auditor	S	P									
States Attorney		S									
County Treasurer		S									
County Sheriff			P	P				P			
Police Chiefs			S	S				S			
Fire Chiefs			S	S				S			
County Engineer					P	P					
County Road Superintendent					P	P					
Tax Equalization Director						P					
Water Management Board						S					
County Extension Agent						S					
County Health Officer							P				
County Health Nurse							S				
Ambulance Services							S	S			
Social Services Director									P		
Ministerial Association									S		
Red Cross									S		
Salvation Army									S		
Superintendent of Schools					S						
DES Coordinator	S	S	S	S	S	S	S	S	S		

COORDINATION AND CONTROL

PRIMARY RESPONSIBILITY: BOARD OF COUNTY COMMISSIONERS

PURPOSE: To provide for coordination of County resources during disaster emergency operations.

RESPONSE TASKS	RESPONSIBILITY	REFERENCE
Activate disaster headquarters	County Commission	A
Provide a briefing for the Emergency Operations Staff	DES Coordinator	A
Coordinate disaster operations	DES Coordinator	All References
Prepare initial report to State government	DES Coordinator	ND Procedures Handbook I, Step 1
Review predetermined *on-scene* disaster coordinator(s)	DES Coordinator	C
Evaluate disaster or emergency situation	County Commission/ DES Coordinator	ND Procedures Handbook I, Step 2 (I/B)
Initiate record keeping and documentation	County Auditor	ND Procedures Handbook I, PGS 10-19
Determine appropriate actions to save lives and protect property	County Commission	ND Procedures Handbook I, Step 2 (J,B)
Prepare situation report to State Government	DES Coordinator	ND Procedures Handbook I, Step 3 (B)
Review and utilize mutual aid agreements	County Commission	D
Provide disaster related public information	DES Coordinator	E

COORDINATION AND CONTROL

RESPONSE TASKS	RESPONSIBILITY	REFERENCE
Declare a local disaster emergency	County Commission	ND Procedures Handbook I, Step 7 (G,B)
Establish curfews, policies and other controls	County Commission	
Request specific assistance from State government to save lives and protect property	County Commission	B ND Procedures Handbook I, Step 4, PG 22
Direct utilization of support resources provided by state government	County Commission	F,H
Continually reassess the disaster situation	County Commission/ DES Coordinator	B ND Procedures Handbook I, Steps 2 & 5 PG 8 & 23
Call for Damage Assessment to begin	County Commission	

NOTE: Specific Contingency Plans (i.e., Flood, Snow Removal, Summer Storms, Hazardous Materials, Wildland and Major Structural Fires) should be referenced in this book independently and should be referenced to the following task: Determine appropriate actions to save lives and protect property.

RECOVERY TASKS	RESPONSIBILITY	REFERENCE
Declare a local disaster emergency	County Commission	B ND Procedures Handbook I, Step 7, PG 46
Request assistance from State government to restore property and recover from the disaster	County Commission	B ND Procedures Handbook I, Step 8, PG 48
Appoint a local overall coordinating officer to recover	County Commission	
Provide a briefing of all emergency function coordinators so they may provide input to Damage Assessment	DES Coordinator	

ADMINISTRATION

PRIMARY RESPONSIBILITY: County Auditor

PURPOSE: To provide a system for handling disaster emergency related legal, fiscal, and administrative matters.

RESPONSE TASKS	RESPONSIBILITY	REFERENCE
Provide administrative support to disaster operations (record keeping, documentation and fiscal)	County Auditor/ County Treasurer	ND Procedures Handbook I, PGS 10-19
Provide legal advice to support disaster operations	States Attorney	
Provide clerical support for the disaster headquarters	County Auditor	
Provide necessary equipment and supplies for operations of disaster headquarters	County Auditor	
Prepare disaster headquarters for emergency operations to include maps and other display materials	County Auditor/ DES Coordinator	

RECOVERY TASKS	RESPONSIBILITY	REFERENCE
Provide administrative support to disaster operations (record keeping, documentation, and fiscal)	County Auditor/ County Treasurer	ND Procedures Handbook I, PGS 10-19
Provide legal advice to support disaster recovery operations	States Attorney	

WARNING

PRIMARY RESPONSIBILITY: County Sheriff

PURPOSE: To establish procedures and provide a network for dissemination of disaster emergency warnings.

RESPONSE TASKS	RESPONSIBILITY	REFERENCE
Receive and disseminate warning	County Sheriff	

COMMUNICATIONS

PRIMARY RESPONSIBILITY: County Sheriff

PURPOSE: To provide the county with a communications network for the transmission of disaster emergency information.

RESPONSE TASKS	RESPONSIBILITY	REFERENCE
Provide a communications network for disaster emergency operations	County Sheriff	
Provide a message routing system within the disaster headquarters	County Sheriff	

PUBLIC WORKS AND ENGINEERING

PRIMARY RESPONSIBILITY: COUNTY ENGINEER/COUNTY HIGHWAY FOREMAN

PURPOSE: To provide for the preservation of life and property through engineering tasks in the County. To provide for snow and debris clearance from streets, highways, shelters, utilities, and essential facilities. To provide for the emergency repair of essential facilities in the County.

RESPONSE TASKS	RESPONSIBILITY	REFERENCE
Activate Public Works and Engineering Staff	County Engineer/ Highway Foreman	A
Maintain public utilities services	Utility Company Mngrs.	A
Provide emergency debris removal	Highway Foreman	A,B,C
Direct support resources	County Engineer/ Highway Foreman	C,F
Coordinate transportation resources	County Supt. of Schools	D
Monitor public and private fuel utilization	County Engineer	F
Maintain roadways, culverts, and bridges	Highway Foreman	A,B,C
Take actions necessary to minimize damage to public and private property (diking, barricading, disconnect utilities, etc.)	Highway Foreman/ County Engineer	A,B,C
Support City government as requested in the above areas	County Commission	A,B,C

(NOTE: Specific Contingency Plans (i.e., Flood, Snow Removal, Summer Storms, Hazardous Materials, Wildland and Major Structural Fires) should be referenced in this book independently and should be referenced to the following tasks. Take actions necessary to minimize damage to public and private property.)

DAMAGE ASSESSMENT

PRIMARY RESPONSIBILITY: COUNTY TAX EQUALIZATION DIRECTOR

PURPOSE: To provide a system for assessing property damage after a disaster emergency in the county.

RECOVERY TASKS	RESPONSIBILITY	REFERENCE
Activate Damage Assessment Staff	Tax Equalization Director	A
Conduct Damage Assessment of:		B,D,C ND Procedures Handbook I, Step 6, PG 25
a. Private residences	Tax Equalization Director	E
b. Private business	Tax Equalization Director	F
c. Private non-profit facilities	Tax Equalization Director	G
d. Agriculture	USDA Emergency Board	H
e. Debris	County Engineer/ Highway Foreman	I
f. Public road systems	County Engineer/ Highway Foreman	J
g. Public utilities	Utility Company Managers	K
h. Public water control facilities	Water Management District	L
i. Public building & equipment	Tax Equalization Director	M
j. Other	Tax Equalization Director	N

HEALTH AND MEDICAL

PRIMARY RESPONSIBILITY: County Health Officer

PURPOSE: To provide for health and medical services in time of a disaster emergency.

RESPONSE TASKS	RESPONSIBILITY	REFERENCE
Provide support for emergency medical care	County Health Officer	
Provide support to control disease through necessary health measures	County Health Officer	

P U B L I C   S A F E T Y

PRIMARY RESPONSIBILITY: County Sheriff

PURPOSE: To provide a means for the protection of life and property and maintenance of law and order during disaster emergency situations.

RESPONSE TASKS	RESPONSIBILITY	REFERENCE
Provide support to maintain law and order	County Sheriff	
Provide support to control and suppress fires	Fire Chiefs	
Provide support to search and rescue efforts	County Sheriff/ Fire Chiefs	

RECOVERY TASKS	RESPONSIBILITY	REFERENCE
Provide support to maintain law and order	County Sheriff	

INDIVIDUAL AND FAMILY ASSISTANCE

PRIMARY RESPONSIBILITY: Social Services Director

PURPOSE: To provide county disaster emergency victims with services tailored to meet special and priority human needs.

RESPONSE TASKS	RESPONSIBILITY	REFERENCE
Activate Individual and Family Assistance personnel	Social Services	A
Provide support to shelter individuals and families left homeless as a result of a disaster emergency	Social Services	B
Provide support to mass feeding operations	Red Cross	C
Provide support for the distribution and storage of clothing and essential items for individuals and families in need as a result of a disaster emergency	Salvation Army	D
Provide support for crisis counseling	Ministerial Assoc.	E
Provide storage sites for personal property during evacuation	Social Services	I

RECOVERY TASKS	RESPONSIBILITY	REFERENCE
Provide support for crisis counseling	Ministerial Assoc.	E
Identify and support disaster assistance centers	Social Services	F,G,H

APPENDIX E

PART 2

WALSH COUNTY NATURAL DISASTER
EMERGENCY OPERATIONS PLANS

Civil Disaster Preparedness Agency

Walsh County

ADMINISTRATIVE BLDG., GRAFTON 58237
PHONE 352-2311

DENNIS J. MARKUSEN, Director-Coordinator

Enclosed is our brochure on "Natural Disaster Emergency Operations Plan" for Walsh County.

Sincerely
Dennis J. Markusen
Walsh County CDPA Coordinator

READ THIS FIRST

Two keys are needed to open the door to disaster assistance. Local governments must:

ONE. *Fulfill their responsibilities, and*

TWO. *Meet certain conditions.*

LOCAL RESPONSIBILITIES

1. By State Law, Chapter 37-17.1, Section 01-21 NDCC, every county and city government must have a program for disaster and emergency prevention, preparedness, response, and recovery. Thus, every city and county government is responsible to be prepared to respond to and recover from most situations themselves, without requesting outside assistance.

2. The Federal Disaster Assistance Act of 1974 states that counties and cities should have plans for coping with all types of disasters and emergencies.

3. North Dakota is an agri-business state. Therefore, it is important that each county have an active United States Department of Agriculture (USDA) Emergency Board to handle agricultural disaster requests, damage assessment, etc.

4. Local governments must be prepared to fund part or all of the costs of securing outside assistance.

LOCAL CONDITIONS

The conditions to meet will vary according to the type of assistance requested.

ASSISTANCE REQUESTED **TO SAVE LIVES AND PROTECT PROPERTY**

CONDITIONS:

1. *Is the assistance requested a requirement to save lives and protect property?*
2. *Is the situation beyond the capabilities of county and/or city governments?*
3. *Has the requesting level of government specified what assistance is required?*

ASSISTANCE REQUESTED **TO RESTORE AND RECOVER**

CONDITIONS:

1. *Is the situation beyond the capabilities of county and/or city governments?*
2. *Has the requesting level of government specified what assistance is required?*
3. *Has a local disaster emergency been declared?*
4. *Has a detailed damage assessment been completed?*
5. *Has the local government specified the disaster emergency related expenditures for which no reimbursement will be asked?*

REQUEST FOR ASSISTANCE

In order to be in the position to request outside assistance, the above conditions must be answered "yes" and <u>in detail</u>.

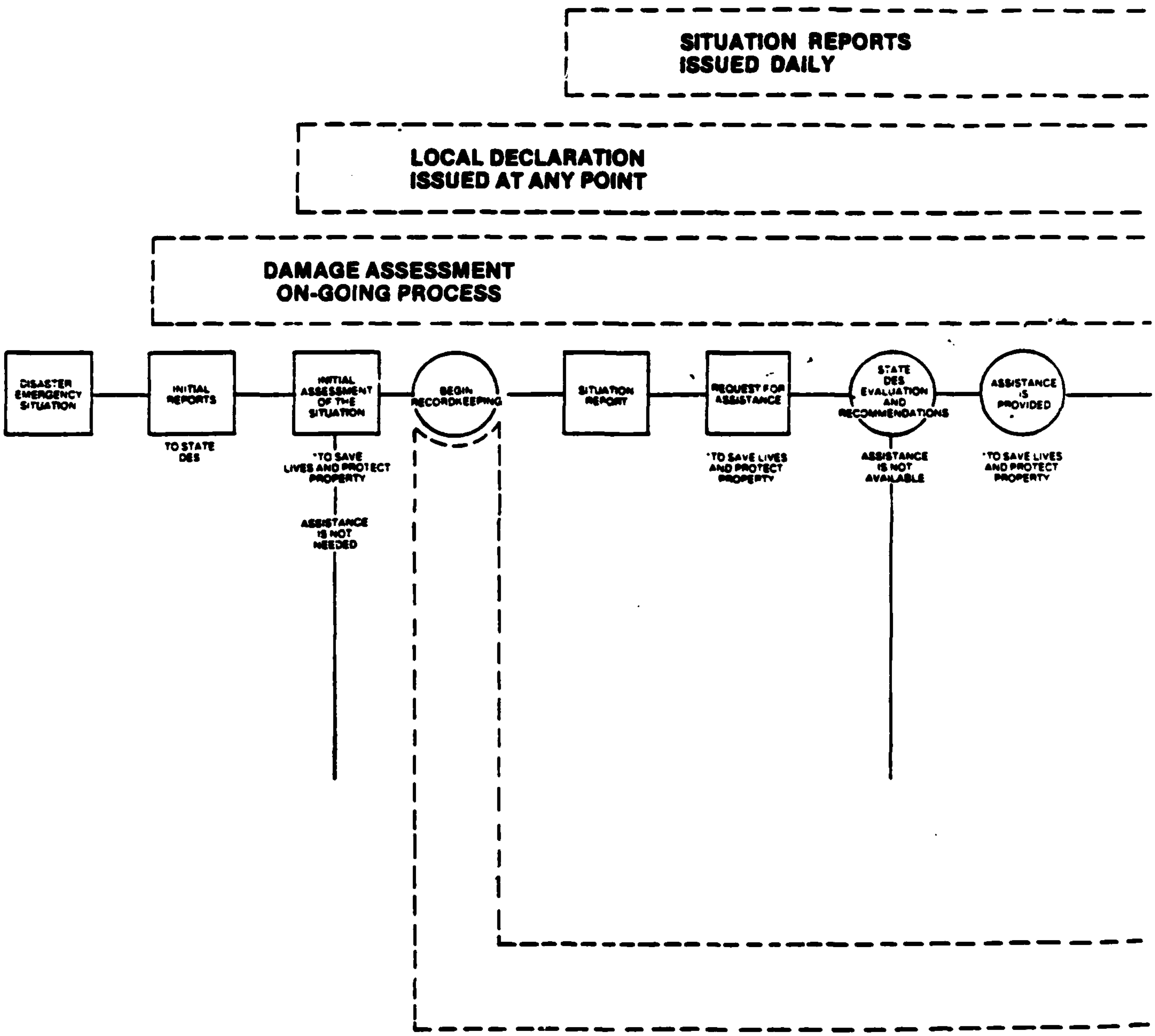
STATE DES ACTION

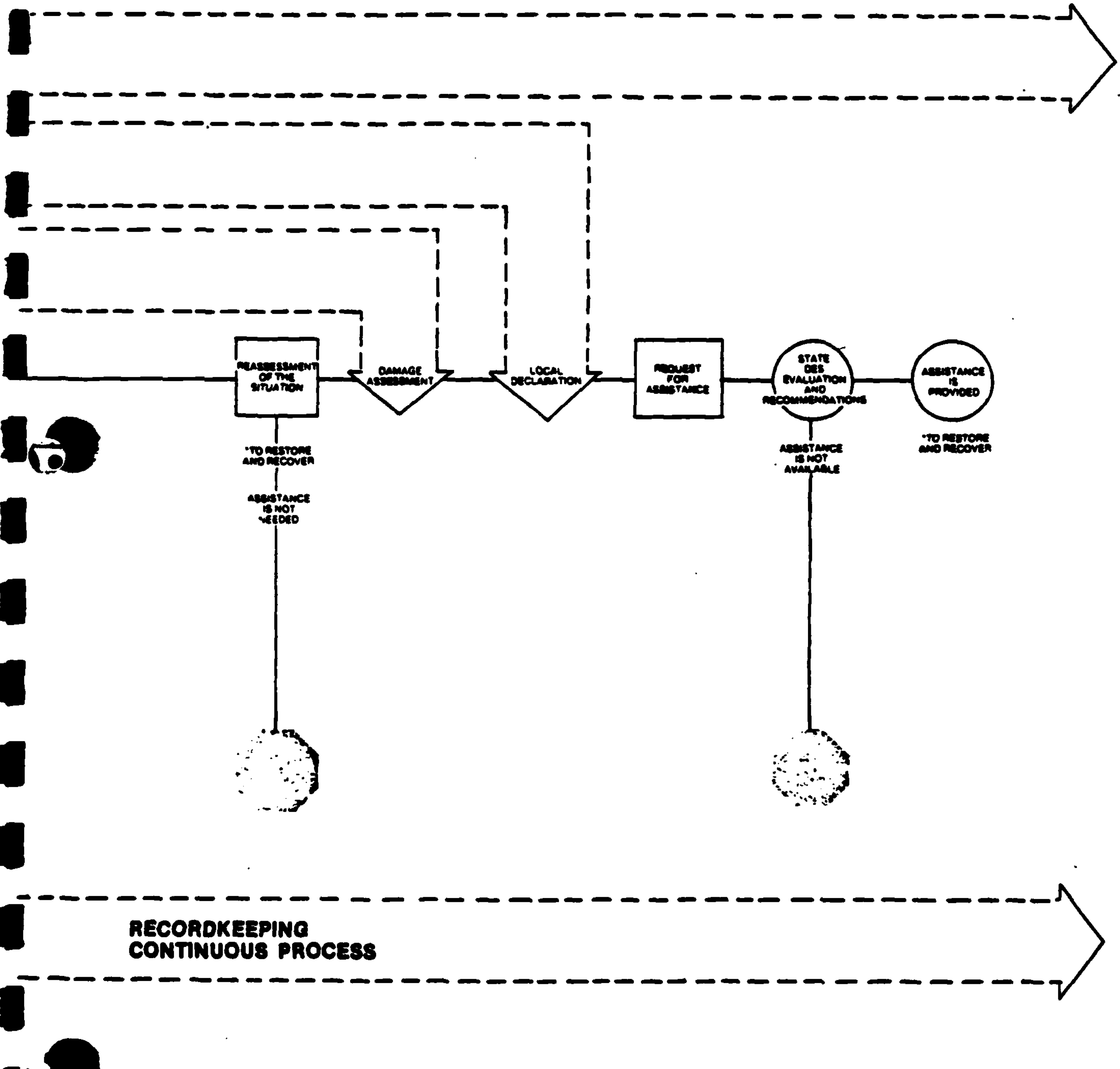
State Disaster Emergency Services (DES), after receiving a valid request for assistance, will determine if there are resources or programs available at State and/or Federal levels to meet the requirements of the situation.

DISASTER PROCEDURES HANDBOOK I

This Disaster Procedures Handbook has been developed to provide a step-by-step explanation identifying the actions which must be taken by a local government to become eligible to gain disaster emergency assistance to respond to (save lives and protect property) and recover from any disaster emergency. It is important that the procedures be followed so that State and Federal assistance can be supplied in a timely and effective manner. The flow-chart on the following two pages visually projects the flow of the procedures discussed throughout this handbook.

PROCEDURES FLOWCHART




REASSESSMENT OF THE SITUATION
DAMAGE ASSESSMENT
LOCAL DECLARATION
REQUEST FOR ASSISTANCE
STATE DES EVALUATION AND RECOMMENDATIONS
ASSISTANCE IS PROVIDED
*TO RESTORE AND RECOVER
ASSISTANCE IS NOT NEEDED
ASSISTANCE IS NOT AVAILABLE
*TO RESTORE AND RECOVER
RECORDKEEPING
CONTINUOUS PROCESS

1

INITIAL REPORT

Contact State Disaster Emergency Services (DES) authorities at the first sign of emergency. This first step is by far the most vital and can seriously affect the success of response and recovery efforts in a disaster emergency situation. Speed is essential. This Initial Report serves to alert State DES and other agencies for subsequent State action if needed. It should contain a brief notification that a disaster emergency situation is imminent or has developed and a general description of the nature and extent of the disaster emergency. Any requests for immediate life-saving assistance should be noted. Use the following guidelines when issuing the Initial Report:

When to Issue--Issue the Initial Report when any disaster emergency is imminent. Some disaster emergencies give no advance warning. If such a disaster emergency occurs, report immediately.

Who to Contact--State Disaster Emergency Services, Bismarck, via State Radio Communications Department

Method of Communication--Telephone (1-800-472-2121), Law Enforcement Radio, Law Enforcement Teletype or NAWAS loop.

Information to Transmit--See sample format on the following page. Answer any additional questions the State Radio Communications Department dispatchers or the Disaster Emergency Services React Officer may ask.

INITIAL REPORT FORMAT

COUNTY/CITY: ______________________________

NAME OF REPORTER: ______________ TITLE: __________

TELEPHONE: ______________________________

DATE/TIME: ______________________________

INFORMATION TO TRANSMIT:

1. AREA AFFECTED: ______________________________

2. TYPE OF DISASTER EMERGENCY: ______________________________

3. WHEN SITUATION WILL BECOME CRITICAL: ______________________________

4. LOCATION OF EOC OR DISASTER HEADQUARTERS: ______________________________

   ______________________ TELEPHONE NO. __________

ADDITIONAL INFORMATION TO TRANSMIT IF APPLICABLE:

5. IS LIFE-SAVING ASSISTANCE NEEDED? WHAT TYPE? __________

6. HAS LOCAL DISASTER EMERGENCY BEEN DECLARED AND BY WHOM? ______________________________

7. OTHER ASSISTANCE NEEDED IF KNOWN AND NAME AND POSITION OF PERSON MAKING REQUEST: ______________________________

2

INITIAL ASSESSMENT OF THE SITUATION

***TO SAVE LIVES AND PROTECT PROPERTY**

Assessment is a continuous process whereby local government officials evaluate either potential or actual conditions and determine the course(s) of action that must be taken to alleviate the disaster emergency conditions. The Initial Assessment centers on the number one priority: <u>Saving Lives and Protecting Property</u>.

The procedure for the assessment of the situation is to:

a. *Determine what has to be accomplished.*

b. *Determine local capabilities to handle the above.*

c. *Determine local government's deficiencies in the above.*

The Checklist on the following page provides guidance to local governments in making an Initial Assessment in any disaster emergency situation. This is a general guideline suggesting emergency activities that should be considered. It is by no means conclusive as different disaster emergencies present different situations.

EMERGENCY ACTIVITIES CHECKLIST

PUBLIC NEEDS

____ Restore Power

____ Communications

____ Transportation

____ Secure Area

____ Debris Clearance

Water Supply:

____ A. Drinking

____ B. Sanitary Sewers, etc.

____ Fire Fighting

Flood Fighting:

____ A. Dike Building

____ B. Sandbagging

____ C. Pumps

____ Other Needs

INDIVIDUAL NEEDS

____ Search and Rescue

____ Evacuation

____ Food

____ Shelter

____ Clothing

____ Medical

____ Victim Identification

____ Mortuary Services

____ Other Needs

ADMINISTRATION

____ Activate EOC

____ Public Announcements

Maps:

____ A. General Disaster Area

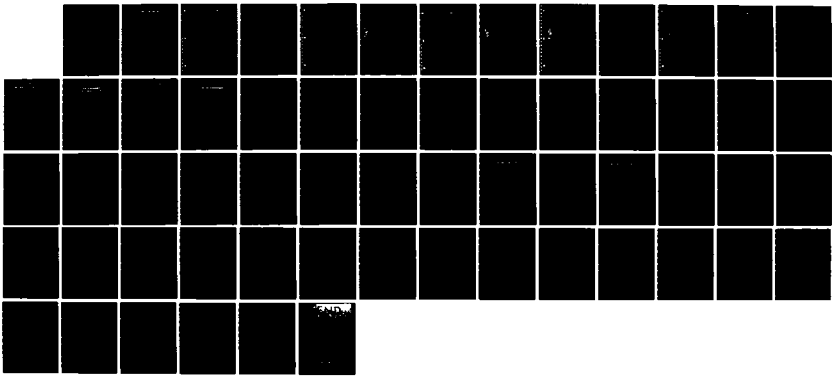
____ B. Specific Damage Sites

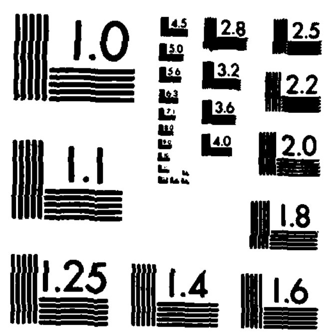
____ C. Location of EOC, DAC, Field Office, Other Strategic Sites

____ Other Needs

AD-A146 629 RED RIVER OF THE NORTH WALSH AND PEMBINA COUNTRIES 4/4
NORTH DAKOTA FARMSTEAD RING LEVEES(U) CORPS OF
ENGINEERS ST PAUL MN ST PAUL DISTRICT DEC 83

UNCLASSIFIED F/G 13/2 NL





OPY RESOLUTION TEST CHART

RECORDKEEPING

It is virtually impossible to accurately and properly complete the necessary recordkeeping after disaster emergency work has been done and a period of time has elapsed. Therefore, the importance of recordkeeping cannot be overemphasized. Local governments must preplan. They must know what records to keep, how to keep them, and have someone familiar enough to start keeping these records immediately upon starting any type of work to respond to the threat or recover from a disaster emergency.

If the situation develops into a major disaster declaration, proper documentation will be needed to justify local expenditures for which reimbursement will be requested. Without proper recordkeeping, local governments stand to lose considerable sums of money because claims for reimbursement cannot be justified. Accurate documentation will also be needed to justify expenditures for which reimbursement will not be requested. This determination is known as the Certification of Commitment.

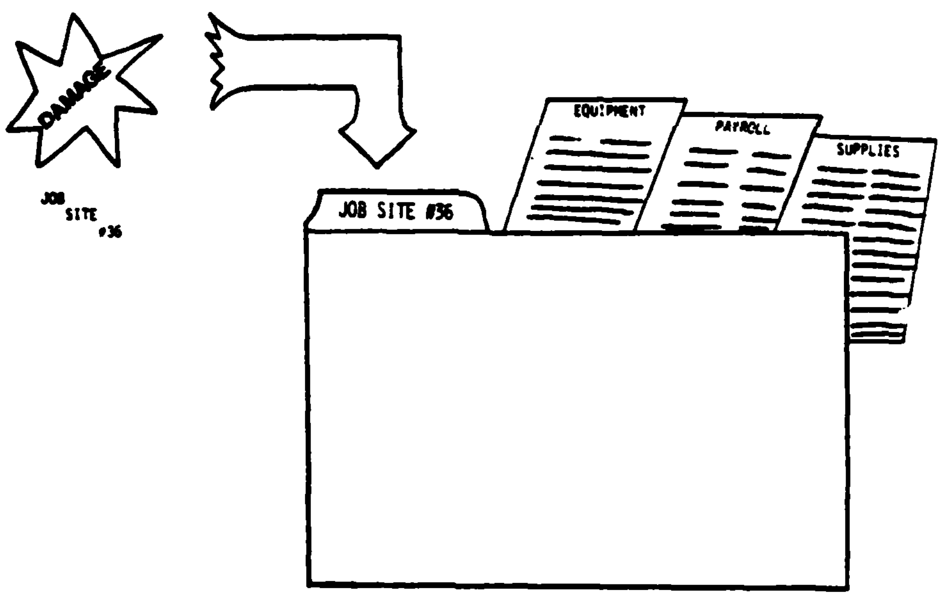
Procedures for proper documentation can be found on the following pages in this section. *If questions arise within the establishment of proper records, call State Disaster Emergency Services - 224-3300.*

DOCUMENTATION REQUIREMENTS

When repair work starts, establish a separate folder for each work project that must be accomplished (as they become known, but no later than the second day after work begins on a particular job). If you have washout damage at five locations that must be repaired right away, establish a separate folder (one for each job site), not one folder for all job sites.

MINIMUM FILING SYSTEM

TO BE MAINTAINED FOR EACH JOB SITE



Basically, there are two ways to complete work at job sites: one is by contract, and the other is by force account, meaning *the utilization of your own personnel, equipment, and supplies.*

CONTRACT WORK

If the work is completed on a lump sum contract, an invoice and copy of the contract is needed. If a cost-type contract is used, the contractor must furnish, in addition to an invoice and copy of contract, a detailed breakdown of all costs, including equipment used, dates used, location of work, hourly rates and hours used. The requirement to furnish this detailed breakdown should be included in the contract. For either type contract, local government must show on each invoice the date and amount paid and check or warrant number or evidence of cost payment. Evidence of the contract advertisement, bidders, and selection of the low-bid contractor should be retained. Cost-plus contracts are not reimbursable.

FORCE ACCOUNT WORK

The documentation for this type of work is quite involved, and immediately after the disaster emergency, someone, preferably a county or city auditor, should start keeping proper records. This person needs to be designated and trained in advance. If a major disaster is declared, he should participate in the briefing for applicants.

If you use another county's or city's resources, the same documentation is required as if the resources were your own. An invoice is required indicating that you have paid the county/city. This invoice must show the date and amount paid, check or warrant number, or evidence of cash payment.

FORCE ACCOUNT PAYROLL

As a minimum, your payroll must show the pay period, name, job classification, number of hours worked each day, total hours worked for pay period, rate of pay (regular and overtime), total earnings, and paycheck number. Your records must also indicate which job site the employee was working on each day and each hour if he worked on more than one job site in a single day.

A Payroll Record Form has been designed to enable you to show who did what and when and for how long on each job site.

It is important to initiate steps whereby you will know on a daily basis who (permanent, temporary, part-time) worked on what disaster emergency-related job for how long, and what he did. These may be turned in daily by each employee or by the foreman. Any type of daily work report form may be used as long as it shows the date, hours worked, job classification, and job site worked on. If an employee works on two or more job sites in a single day, he should turn in a separate work report for each.

If desired, you could transcribe the information from the daily reports to your payroll system, and then file the daily report in the proper job folder. Having done this, the Payroll Record Form could then be brought up to date on a periodic basis. It is recommended that this be done at least once each week.

COMPLETE ONLY AFTER MAJOR DISASTER DECLARATION

FEMA-____________-DR

PROJECT APPLICATION NO.: ____________________

CATEGORY OF WORK: ________ LINE ITEM: ________

FORCE ACCOUNT PAYROLL RECORD

PAGE ________ OF ________ PAGES

TIME PERIOD: ____________ TO ____________ 19 ____

LOCATION: ________________________ JOB SITE NO.: ____________

NAME	JOB CLS.	DATE / HOURS WORKED EACH DAY															TOTAL HOURS	RATE	TOTAL PAY	PAYCHK. NUMBER

TOTAL HOURS ________ TOTAL PAY ________

CERTIFIED BY: ____________________ TITLE: ____________________

FORCE ACCOUNT EQUIPMENT

Equipment, both applicant owned and rented, used on each particular job site must be fully documented. Specifically, the documentation must show the type and description, date used, hours used each day, total hours used, rate per hour (equipment only), total cost for each, and total cost of all equipment used.

If the equipment is rented, you must also show the date and amount paid and check number or evidence of cash payment. The rental agreement must specifically state who must pay for all repairs and a copy of the agreement must be retained in the job site file.

Rates* used on applicant-owned equipment must be no more than those approved on the current Federal schedule of applicant-owned equipment rates. A copy of these rates can be obtained through State Disaster Emergency Services.

It is strongly urged that local governments use the Equipment Record Form to document the above information for equipment used on each specific job site. You should place an Equipment Record Form in each job folder immediately upon starting work, and record daily the use of any equipment on this form. A vendor invoice folder should also be established for vendor invoices and rental agreements if any rental equipment is used. Local governments may want to use daily written (form) reports or daily oral reports from foremen to record equipment usage.

*Rates do not include operator; operator's time should be indicated on Force Account Payroll Record.

FORCE ACCOUNT EQUIPMENT RECORD

COMPLETE ONLY AFTER MAJOR DISASTER DECLARATION

FEMA-__________-DR

PROJECT APPLICATION NO.: __________

CATEGORY OF WORK: ________ LINE ITEM: ________

PAGE ______ OF ______ PAGES

TIME PERIOD: __________ TO

__________ 19 ____

LOCATION: ________________ JOB SITE NO.: ________

TYPE OF EQUIPMENT	EQUIP. NO. REFERENCE	DATE / HOURS USED EACH DAY															TOTAL HRS.	RATE	TOTAL COST
																TOTAL HRS.		TOTAL COST	

CERTIFIED BY: ________________ TITLE: ________________

COMPLETE ONLY AFTER MAJOR DISASTER DECLARATION

FEMA-__________-DR

PROJECT APPLICATION NO.: __________

CATEGORY OF WORK: ________ LINE ITEM: ________

FORCE ACCOUNT RENTED EQUIPMENT RECORD

PAGE ______ OF ______ PAGES

TIME PERIOD: __________ TO __________ 19 ___

LOCATION: ________________ JOB SITE NO.: ______

TYPE OF EQUIPMENT	DATE USED	HRS. USED	RATE PER HOUR		TOTAL COST	VENDOR	INVOICE NO.	DATE PAID	AMT. PAID	CHECK NUMBER
			W/OPR	WO/OPR						

CERTIFIED BY: ________________ TITLE: ________________

FORCE ACCOUNT SUPPLIES

Materials and supplies, both purchased and from stock, used on each particular job site must be fully documented. Specifically, the documentation must show the unit price (may be averaged from stock cards), total cost, quantity, description, date purchased, date used, job used on, date paid for, and amount and check number or evidence of cash payment. It is strongly suggested that local governments use the Supply Record Form to document daily the above information for materials used on each specific job site.

Immediately upon starting to work and establishing a folder for a particular job, place a Supply Record Form in the folder. Each time any materials are used on the job, record the information on the form.

A file separate from job folders should be established for vendor invoices on materials that are being, or will be, used on job sites. This will enable you to easily find the information needed when recording materials used on the Supply Record Form. You may use recently purchased materials or materials that have been in stock for some time for which the vendor's invoice has not yet been received or has been destroyed. If you have no invoice, confirm the needed information with the vendor and make up a city or county claim voucher for the vendor invoice file. Local governments may want to use daily written (form) reports or daily oral reports from foremen to record expenditures of materials.

COMPLETE ONLY AFTER MAJOR DISASTER DECLARATION

FEMA-__________-DR

PROJECT APPLICATION NO.: __________

CATEGORY OF WORK: ______ LINE ITEM: ______

FORCE ACCOUNT SUPPLY RECORD

PAGE _____ OF _____ PAGES

TIME PERIOD: __________ TO __________ 19 ____

LOCATION: ____________________ JOB SITE NO.: ______

VENDOR	DESCRIPTION	QUANTITY	UNIT PRICE	TOTAL PRICE	DATE BOUGHT	CHECK NUMBER	DATE USED	CHECK ONE INFORMATION FROM	
								INVOICE	STOCK
			TOTAL PRICE						

I certify that the above information was transcribed from vendor invoices, stock cards or other documents which are available for audit.

CERTIFIED BY: ____________________ TITLE: ____________________

3

SITUATION REPORTS

During any disaster emergency, it is essential that reports of the situation, as it unfolds, be made to State Disaster Emergency Services. These reports aid State and Federal agencies in their efforts to provide timely and adequate assistance to a local area.

The guidelines herein provide a standardized report format to be utilized throughout our State.

When to Issue--Issue as soon as practical after the emergency, and at least daily thereafter. Reports should be sent more often if significant changes in the situation have occurred or have the probability of occurring.

Who to Contact--State Disaster Emergency Services.

Method of Communication--Priority message (teletype), telephone or radio if teletype is not available.

Law Enforcement Teletype:
Attention: State Disaster Emergency Services

Telephone: 224-3300

Law Enforcement Radio:
Attention: State Emergency Operations Center

Information to Transmit--See format on following page.

Information given in one Situation Report should not be repeated in the following Situation Reports. Use "no change" unless additional information is available. Use "N/A" if topic does not apply.

SITUATION REPORT FORMAT

COUNTY/CITY: ____________________

NAME OF REPORTER/SOURCE: ____________________

DATE/TIME: ____________________

INFORMATION TO TRANSMIT:

1. NATURE OF DISASTER: *Type of emergency, location.*

2. DEATH AND INJURIES: *Total deaths to date, total injuries to date--include location where practical.*

3. DAMAGE: *Type and extent of property damage, especially as this directly affects people--e.g., damage to housing, food supplies, medical resources, water and sewage service. Also include special damage problems, such as damage to key utilities, communication facilities, medical resources, major military, or major transportation facilities--e.g., major highways, bridges, rail routes, airports. Indicate any additional damage potential as a result of the emergency.*

4. LOCAL RESOURCES COMMITTED: *This includes warning, use of personnel, shelter supplies, engineering equipment.*

5. VOLUNTEER ACTIONS: *Indicate actions taken by the American Red Cross, Salvation Army, Mennonites, Seventh Day Adventists or other volunteer groups--e.g., number of meals served, number of individuals clothed, number of families sheltered and general assistance provided.*

6. LOCAL ACTIONS: *Major local actions, such as declaration of disaster, requests for Federal assistance, public announcements or instructions, activation of EOC, emergency plan, evacuation, rescue, etc.*

7. ASSISTANCE NEEDED IF KNOWN AND NAME AND POSITION OF PERSON MAKING REQUEST: *Requests for assistance should be specific, not just a request stating, "Send all available help." Military support requests should be described in mission terms--e.g., search flooded area from A to B for trapped persons.*

8. OUTSIDE HELP ON SCENE: *Name all State or Federal agencies providing assistance within the area.*

9. OTHER INFORMATION: *Other data and remarks not covered above.*

4

REQUEST FOR ASSISTANCE

•TO SAVE LIVES AND PROTECT PROPERTY

After assessing the situation, if the local government determines that it is beyond the capability of the community to save lives and protect property, the next step should be to immediately contact local resources (rescue teams, contractors, volunteer fire departments, etc.). They have the capability of quick response.

If the situation requires additional assistance, a request for State and Federal assistance should be made through State Disaster Emergency Services. They will evaluate State and Federal capabilities to determine which agencies can provide appropriate life and property-saving assistance. State DES will then coordinate with the proper agencies to insure that assistance made available is provided.

When to Request--Request only if assistance is needed to save lives and protect property.

Who to Contact--State Disaster Emergency Services, Bismarck, via State Radio Communications Department.

Method of Communication--Telephone (1-800-472-2121), Law Enforcement Radio, Law Enforcement Teletype or NAWAS loop.

Information to Submit--

1. Specific needs.
2. Contact person(s).

5

REASSESSMENT OF THE SITUATION

***TO RESTORE AND RECOVER**

Once the life saving and property protection phase of a disaster emergency situation is no longer a consideration, restoration and recovery becomes the number one priority. Therefore, the situation should be reassessed.

The procedure for Reassessment of the Situation is to:

a. Determine what has to be accomplished.

b. Determine local capabilities to handle the above.

c. Determine local governments' deficiencies in the above.

From these determinations local governments are made aware of actual conditions. They must now make a fourth determination: What course of action should be taken? Only two avenues are available:

1. Handle restoration and recovery on their own.
2. Request outside assistance through State Disaster Emergency Services.

The Checklist on the following page provides a general guideline suggesting restoration and recovery activities that should be considered.

RESTORATION AND RECOVERY CHECKLIST

PUBLIC DAMAGE

- ____ debris
- ____ roads, streets, culverts
- ____ bridges
- ____ public buildings
- ____ equipment and vehicles
- ____ materials and supplies
- ____ utilities
- ____ water supply
- ____ sewer systems
- ____ water control facilities
- ____ communications systems
- ____ parks and recreation areas
- ____ nonprofit facilities

INDIVIDUAL NEEDS

- ____ food
- ____ clothing
- ____ temporary housing
- ____ assistance for homeowners
- ____ assistance for businessmen
- ____ assistance for farmers and ranchers
- ____ assistance to private nonprofit facilities
- ____ replacement of personal property
- ____ unemployment assistance
- ____ debris removal
- ____ crisis counseling
- ____ health and sanitation
- ____ public safety

6

DAMAGE ASSESSMENT

Damage assessment is an extremely critical disaster emergency function. It must begin whenever damage first takes place and continue until damage no longer occurs.

The purpose of a Damage Assessment Report is to develop information as to the severity and magnitude of the disaster emergency. Damage Assessment Reports, in addition to the Situation Reports, provide the information needed by the Governor in making a request for Federal assistance.

When to Complete--The Damage Assessment Report should be completed when a local government believes outside assistance is necessary to supplement its available resources and efforts in recovery and restoration operations.

Who Shall Complete the Report--A local representative(s) of the affected area who knows how important this function really is to the management of the disaster or emergency.

Who Shall Receive the Report--State Disaster Emergency Services, Box 1817, Bismarck, ND 58505

What Shall Be Included in the Report--Completed applicable damage assessment forms. (See the following forms.) Pictures and maps should also accompany the report.

NORTH DAKOTA DAMAGE ASSESSMENT REPORT
Private Residences

COUNTY	POLITICAL SUBDIVISION

	APPROXIMATE VALUE PER UNIT	DAMAGE			
		*UNINHABIT-ABLE	MINOR	MAJOR	DESTROYED
LOW COST HOMES					
MEDIUM COST HOMES					
HIGH COST HOMES					
MOBILE HOMES					
MULTIPLE DWELLING UNITS (APARTMENTS)					
*DWELLINGS WITHOUT UTILITIES OR ACCESS, EVEN THOUGH NO PHYSICAL DAMAGE SUSTAINED.	TOTALS:				

SURVEYED BY:	TITLE:	PHONE:	DATE:

PAGE ______ OF ______ PAGES

PRIVATE RESIDENCES

Instructions:

1. Indicate county, political subdivision.
2. Indicate the approximate average value per unit for each group of homes or dwelling units affected by the disaster.
3. As each unit is inspected, decide upon a damage rating of minor, major, or destroyed, and place a "tally mark" in the appropriate box. Place a "tally mark" for each unit of a multiple dwelling.

   Example: An eight-unit apartment building would receive eight "tally marks"; a duplex, two. Use the following criteria for rating:

MINOR	MAJOR	DESTROYED
May still be used for its intended purpose or may be restored to service with minimal repairs.	Cannot be used or may be used under limited conditions or reduced levels of service or may be restored to use with extensive repairs.	No longer exists or is damaged to the extent that it is no longer usable and that restoration to use is not technically or economically feasible.

   *In the UNINHABITABLE box, indicate those dwellings which sustained no physical damage but which are without utilities or access.

4. Total the "tally marks" in each box and then total each column.
5. Sign, date, and forward to State Disaster Emergency Services, Box 1817, Bismarck, ND 58505.

NORTH DAKOTA DAMAGE ASSESSMENT REPORT
Private Residences

COUNTY: Scott
POLITICAL SUBDIVISION: Millenville
Parlow's First Edition

	APPROXIMATE VALUE PER UNIT	DAMAGE: *UNINHABITABLE	MINOR	MAJOR	DESTROYED
LOW COST HOMES	$20,000	~~||||~~ ~~||||~~ 10	~~||||~~ 5	||| 3		1
MEDIUM COST HOMES	$40,000	0	~~||||~~ ~~||||~~	11	~~||||~~	6	|||| 4
HIGH COST HOMES	$70,000		1	||| 3	|| 2	0
MOBILE HOMES	$10,000	~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ||| 23	||| 3	~~||||~~	6	~~||||~~ ~~||||~~ 10
MULTIPLE DWELLING UNITS (APARTMENTS)	$30,000	0	0	~~||||~~ ||| 8	|| 2
*DWELLINGS WITHOUT UTILITIES OR ACCESS, EVEN THOUGH NO PHYSICAL DAMAGE SUSTAINED	TOTALS:	34	22	25	17

SURVEYED BY: Eugene Fuhel | TITLE: Building Inspector | PHONE: 555-5555 | DATE: 5/5/55

PAGE 1 OF 1 PAGES

NORTH DAKOTA DAMAGE ASSESSMENT REPORT
Private Business

COUNTY	POLITICAL SUBDIVISION	DAMAGE: MINOR	DAMAGE: MAJOR	DAMAGE: DESTROYED	ESTIMATED DOLLAR VALUE OF DAMAGE
COMMERCIAL					
CUSTODIAL CARE					
UTILITY	GAS				
	POWER				
	TELEPHONE				
CLINIC					
OTHER (EXPLAIN)					
	TOTALS:				

CERTIFIED BY:	TITLE	PHONE:	DATE:

PAGE ______ OF ______ PAGES

PRIVATE BUSINESS

Instructions:

1. Indicate county and political subdivision.
2. As each business is inspected, decide upon a damage rating of minor, major, or destroyed, and place a "tally mark" in the appropriate box according to type of business. Most businesses will be classified as "commercial".

   Use the following criteria for rating:

MINOR	MAJOR	DESTROYED
May still be used for its intended purpose or may be restored to service with minimal repairs.	Cannot be used or may be used under limited conditions or reduced levels of service or may be restored to use with extensive repairs.	No longer exists or is damaged to the extent that it is no longer usable and that restoration to use is not technically or economically feasible.

3. Total the "tally marks" in each box and then total each column.
4. Estimate the dollar value of damage for each classification of business and then total the column.
5. Sign, date, and forward to State Disaster Emergency Services, Box 1817, Bismarck, ND 58505.

NORTH DAKOTA DAMAGE ASSESSMENT REPORT
Private Business

COUNTY: Scott
POLITICAL SUBDIVISION: MillerVille

		DAMAGE: MINOR	DAMAGE: MAJOR	DAMAGE: DESTROYED	ESTIMATED DOLLAR VALUE OF DAMAGE
COMMERCIAL		𝍸 III 8	𝍸 II 7	II 2	$740,000
CUSTODIAL CARE		0	I 1	0	$160,000
UTILITY	GAS	0	0	0	0
UTILITY	POWER	I 1	0	0	$1,200,000
UTILITY	TELEPHONE	0	0	0	0
CLINIC		I 1	0	0	$30,000
OTHER (EXPLAIN)		0	0	0	0
	TOTALS:	10	8	2	$2,130,000

CERTIFIED BY: PhilipC. Miller TITLE: MAYOR PHONE: 666-6666 DATE: 5/5/55

PAGE 1 OF 1 PAGES

NORTH DAKOTA DAMAGE ASSESSMENT REPORT

Private Nonprofit Facilities

COUNTY	POLITICAL SUBDIVISION

Description of Damage: Function, Location, Damage to Structure or Equipment, etc.	TYPE (✓) EDUCATIONAL	CUSTODIAL	EMERGENCY	WATER CONTROL	UTILITY	MEDICAL	RELIGIOUS		DAMAGE (✓) MINOR	MAJOR	DESTROYED	FOR STATE USE ONLY
TOTALS:												

CERTIFIED BY:	TITLE:	PHONE:	DATE:

PAGE ____ OF ____ PAGES

AGRICULTURE

NATURAL DISASTER DAMAGE ASSESSMENT REPORT

Instructions:

Obtain a completed copy of the Natural Disaster Damage Assessment Report from the County Emergency Board and forward to State Disaster Emergency Services, Box 1817, Bismarck, ND 58505.

NORTH DAKOTA DAMAGE ASSESSMENT REPORT
Debris

COUNTY

POLITICAL SUBDIVISION

MAP NUMBER	Description: Location, Facility affected, e.g., Roads, Building Access, Drainage, Water and Sewer, etc.	AMOUNT (✓)		PROPERTY AFFECTED (✓)			TYPE (✓)			FOR STATE USE ONLY
		CONCENTRATED	DISBURSED	PUBLIC	PRIVATE	AGRICULTURAL	BUILDING MATERIALS	TREES/ VEGETATION	ROCK, SILT, GRAVEL	
	TOTALS:									

CERTIFIED BY: TITLE: PHONE: DATE:

PAGE ____ OF ____ PAGES

DEBRIS

Instructions:

1. Indicate county and political subdivision.
2. Write a description of the location and type of facility affected.
3. Prepare a map which numbers the area affected by debris. Use a map with a scale of 1/2-inch equals one mile, such as a State Highway Planning Map.
4. Next to the description of the affected area, write the corresponding map number.
5. "Check" the amount, property affected, and type of debris.
6. Total each column.
7. Sign, date, and forward to State Disaster Emergency Services, Box 1817, Bismarck, ND 58505.

NORTH DAKOTA DAMAGE ASSESSMENT REPORT
Debris

COUNTY: Scott

POLITICAL SUBDIVISION: Millerville

MAP NUMBER	Description: Location, Facility affected, e.g., Roads, Building, Access, Drainage, Water and Sewer, etc.	AMOUNT (✓) Concentrated	AMOUNT (✓) Dispersed	PROPERTY AFFECTED (✓) Public	PROPERTY AFFECTED (✓) Private	PROPERTY AFFECTED (✓) Agricultural	TYPE (✓) Building Materials	TYPE (✓) Trees, Vegetation	TYPE (✓) Rocks, Silt, Gravel	FOR STATE USE ONLY
1	Riverview Park - six inch silt and trash in Park		✓	✓					✓	
2	Both banks Blue River From Sewage Plant South to Dept of Public Works Equipment yard - mud deposits 12" deep		✓	✓					✓	
3	"A" street ¼ mile 6" silt deposits	✓		✓					✓	
4	"A" street ¼ mile 6" silt deposits on Private Property	✓			✓				✓	
	TOTALS	2	2	3	1	0	0	0	4	

CERTIFIED BY: Philip C. Miller TITLE: Mayor PHONE: 666-6666 DATE: 6/5/55

NORTH DAKOTA DAMAGE ASSESSMENT REPORT
Public Road Systems

COUNTY

POLITICAL SUBDIVISION

MAP NUMBER	Description of Damage: Dimensions, Type of Construction, etc.	SYSTEM (✓)			SITE (✓)					DAMAGE (✓)			FOR STATE USE ONLY
		FAS	NON FAS		ROADWAY	BRIDGE	CULVERT	DRAINAGE		MINOR	MAJOR	DESTROYED	
	TOTALS:												

CERTIFIED BY: TITLE: PHONE: DATE:

PAGE ____ OF ____ PAGES

PUBLIC ROAD SYSTEMS

Instructions:

1. Indicate county and political subdivision.

2. Write a description of the damage.

3. Prepare a map which numbers the damaged site. Use a map with a scale of 1/2-inch equals one mile, such as a State Highway Planning Map.

4. Next to the description of damage, write the corresponding map number.

5. "Check" the type of system and site.

6. As each item is inspected, decide upon a damage rating of minor, major, or destroyed, and place a "check" in the appropriate box.

   Use the following criteria for rating:

MINOR	MAJOR	DESTROYED
May still be used for its intended purpose or may be restored to service with minimal repairs.	Cannot be used or may be used under limited conditions or reduced levels of service or may be restored to use with extensive repairs.	No longer exists or is damaged to the extent that it is no longer usable and that restoration to use is not technically or economically feasible.

7. Total each column.

8. Sign, date, and forward to State Disaster Emergency Services, Box 1817, Bismarck, ND 58505.

NORTH DAKOTA DAMAGE ASSESSMENT REPORT
Public Road Systems

COUNTY: SCOTT
POLITICAL SUBDIVISION: MILLERVILLE

		SYSTEM (✓)			SITE (✓)					DAMAGE (✓)			
MAP NUMBER	Description of Damage: Dimensions, Type of Construction, etc.	FAS	NON FAS		ROADWAY	BRIDGE	CULVERT	DRAINAGE		MINOR	MAJOR	DESTROYED	FOR STATE USE ONLY
1	1/4 mile paved River Rd. washed out.		✓		✓						✓		
2	Left abutment settled - Wilson Bridge.		✓			✓					✓		
3	Paved approaches and shoulders to Wilson Bridge damaged by high water.		✓		✓						✓		
	TOTALS	0	3	0	2	1	0	0	0	0	3	0	

CERTIFIED BY: P.C. Miller
TITLE: Mayor
PHONE: 666-6666
DATE: 5/5/55

NORTH DAKOTA DAMAGE ASSESSMENT REPORT

Public Utilities

MAP NUMBER	COUNTY	POLITICAL SUBDIVISION	TYPE (✓)				DAMAGE (✓)			FOR STATE USE ONLY
	Description of Damage: Function or Use, Length etc.		GAS	POWER	WATER	SANITARY	MINOR	MAJOR	DESTROYED	
		TOTALS:								

CERTIFIED BY: | TITLE: | PHONE: | DATE:

PAGE ___ OF ___ PAGES

PUBLIC UTILITIES

Instructions:

1. Indicate county and political subdivision.
2. Write a description of the damage.
3. Prepare a map which numbers the damaged site. Use a map with a scale of 1/2-inch equals one mile, such as a State Highway Planning Map.
4. Next to the description of damage, write the corresponding map number.
5. "Check" the type of utility affected.
6. As each item is inspected, decide upon a damage rating of minor, major, or destroyed, and place a "check" in the appropriate box.

   Use the following criteria for rating:

MINOR	MAJOR	DESTROYED
May still be used for its intended purpose or may be restored to service with minimal repairs.	Cannot be used or may be used under limited conditions or reduced levels of service or may be restored to use with extensive repairs.	No longer exists or is damaged to the extent that it is no longer usable and that restoration to use is not technically or economically feasible.

7. Total each column.
8. Sign, date, and forward to State Disaster Emergency Services, Box 1817, Bismarck, ND 58505.

NORTH DAKOTA DAMAGE ASSESSMENT REPORT
Public Utilities

COUNTY: SCOTT | POLITICAL SUBDIVISION: MILLERVILLE

MAP NUMBER	Description of Damage: Function or Use, Length etc.	TYPE (✓) GAS	POWER	WATER	SANITARY	DAMAGE (✓) MINOR	MAJOR	DESTROYED	FOR STATE USE ONLY
1	Watermain broken for approximately 50 ft.			✓			✓		
2	Sewer line cracked and being closed up by silt accumulations.				✓		✓		
3	Running water has caused erosion to north wall of the city's lagoon #1. Silt build-up also present.				✓	✓			
	TOTALS	0	0	1	2	1	2	0	

CERTIFIED BY: D.C. Miller TITLE: Mayor PHONE: 666-6666 DATE: 5/5/85

1 of 3 pages

NORTH DAKOTA DAMAGE ASSESSMENT REPORT
Public Water Control Facilities

COUNTY | POLITICAL SUBDIVISION

MAP NUMBER	Description of Damage: Type of Construction, Dimensions, etc.	TYPE (✓) DAM	DIKE	LEVEE	IRRIGATION	DRAINAGE	OTHER	DAMAGE (✓) MINOR	MAJOR	DESTROYED	FOR STATE USE ONLY
	TOTALS:										

CERTIFIED BY: | TITLE: | PHONE: | DATE:

PUBLIC WATER CONTROL FACILITIES

Instructions:

1. Indicate county and political subdivision.
2. Write a description of the damage.
3. Prepare a map which numbers the damaged site. Use a map with a scale of 1/2-inch equals one mile, such as a State Highway Planning Map.
4. Next to the description of damage, write the corresponding map number.
5. "Check" the type of facility affected.
6. As each item is inspected, decide upon a damage rating of minor, major, or destroyed, and place a "check" in the appropriate box.

   Use the following criteria for rating:

MINOR	MAJOR	DESTROYED
May still be used for its intended purpose or may be restored to service with minimal repairs.	Cannot be used or may be used under limited conditions or reduced levels of service or may be restored to use with extensive repairs.	No longer exists or is damaged to the extent that it is no longer usable and that restoration to use is not technically or economically feasible.

7. Total each column.
8. Sign, date, and forward to State Disaster Emergency Services, Box 1817, Bismarck, ND 58505.

NORTH DAKOTA DAMAGE ASSESSMENT REPORT
Public Water Control Facilities

COUNTY: SCOTT
POLITICAL SUBDIVISION: MILLERVILLE

MAP NUMBER	Description of Damage: Type of Construction, Dimensions, etc.	TYPE (✓) DAM	DIKE	LEVEE	IRRIGATION	DRAINAGE	OTHER	DAMAGE (✓) MINOR	MAJOR	DESTROYED	FOR STATE USE ONLY
1	Wave action erosion on entire front of 90' x 30' x 15' earth filled dam.	✓						✓			
2	Rip-rap washed away for 300 yards between 6th and 9th streets.		✓						✓		
3	Levee breached for 500 yards.			✓				✓			
4	Storm sewers severely washed out at northern edge of city.					✓			✓		
	TOTALS	1	1	1	0	1	0	2	2	0	

CERTIFIED BY: P.C. Miller TITLE: Mayor PHONE: 666-6666 DATE: 5/5/85

Page 1 of 3

NORTH DAKOTA DAMAGE ASSESSMENT REPORT
Public Buildings & Equipment

COUNTY

POLITICAL SUBDIVISION

MAP NUMBER	Description of Damage: Size and Type of Construction, Function or Use of Each, etc.	TYPE (✓) BUILDING	EQUIPMENT/ VEHICLES	MATERIALS SUPPLIES	DAMAGE (✓) MINOR	MAJOR	DESTROYED	FOR STATE USE ONLY
	TOTALS:							

CERTIFIED BY:	TITLE:	PHONE:	DATE:

PAGE ____ OF ____ PAGES

PUBLIC BUILDINGS & EQUIPMENT

Instructions:

1. Indicate county and political subdivision.
2. Write a description of the damage.
3. Prepare a map which numbers the damaged site. Use a map with a scale of 1/2-inch equals one mile, such as a State Highway Planning Map.
4. Next to the description of damage, write the corresponding map number.
5. "Check" the type of facility affected.
6. As each item is inspected, decide upon a damage rating of minor, major, or destroyed, and place a "check" in the appropriate box.

   Use the following criteria for rating:

MINOR	MAJOR	DESTROYED
May still be used for its intended purpose or may be restored to service with minimal repairs.	Cannot be used or may be used under limited conditions or reduced levels of service or may be restored to use with extensive repairs.	No longer exists or is damaged to the extent that it is no longer usable and that restoration to use is not technically or economically feasible.

7. Total each column.
8. Sign, date, and forward to State Disaster Emergency Services, Box 1817, Bismarck, ND 58505.

NORTH DAKOTA DAMAGE ASSESSMENT REPORT
Public Buildings & Equipment

COUNTY: SCOTT

POLITICAL SUBDIVISION: MILLERVILLE

Map Number	Description of Damage: Size and Type of Construction, Function or Use of Each, etc.	Type (✓) Buildings	Type (✓) Equipment/Vehicles	Type (✓) Materials/Supplies	Damage (✓) Minor	Damage (✓) Major	Damage (✓) Destroyed	For State Use Only
1	Dept. Public Works – Public office building and garage. Garage area flooded 6" water. 2" silt deposits.	✓			✓			
2	Dept. Public Works – Mechanic's tools and equipment damaged by water.		✓		✓			
3	City Sewage Plant – Electrical system flooded.	✓					✓	
4	Veteran's Memorial Library – Basement flooded, utilities all water-saturated. Two feet of silt in basement.	✓				✓		
	TOTALS	3	1	0	2	1	1	

CERTIFIED BY: P. C. Miller TITLE: Mayor PHONE: 666-6666 DATE: 6/5/85

NORTH DAKOTA DAMAGE ASSESSMENT REPORT
Public Other

COUNTY

POLITICAL SUBDIVISION

MAP NUMBER	Description of Damage: Type, Use, Construction Type, Dimensions, etc.	TYPE (✓) RECREATION	TRANSPORTATION	COMMUNICATION			DAMAGE (✓) MINOR	MAJOR	DESTROYED	FOR STATE USE ONLY
	TOTALS:									

CERTIFIED BY: TITLE: PHONE: DATE:

PAGE ___ OF ____ PAGES

PUBLIC OTHER

Instructions:

1. Indicate county and political subdivision.
2. Write a description of the damage.
3. Prepare a map which numbers the damaged site. Use a map with a scale of 1/2-inch equals one mile, such as a State Highway Planning Map.
4. Next to the description of damage, write the corresponding map number.
5. "Check" the type of facility affected.
6. As each item is inspected, decide upon a damage rating of minor, major, or destroyed, and place a "check" in the appropriate box.

   Use the following criteria for rating:

MINOR	MAJOR	DESTROYED
May still be used for its intended purpose or may be restored to service with minimal repairs.	Cannot be used or may be used under limited conditions or reduced levels of service or may be restored to use with extensive repairs.	No longer exists or is damaged to the extent that it is no longer usable and that restoration to use is not technically or economically feasible.

7. Total each column.
8. Sign, date, and forward to State Disaster Emergency Services, Box 1817, Bismarck, ND 58505.

NORTH DAKOTA DAMAGE ASSESSMENT REPORT
Public Other

COUNTY: SCOTT

POLITICAL SUBDIVISION: MILLERVILLE

MAP NUMBER	Description of Damage: Type, Use, Construction Type, Dimensions, etc.	TYPE (✓) RECREATION	TRANSPORTATION	COMMUNICATION				DAMAGE (✓) MINOR	MAJOR	DESTROYED	FOR STATE USE ONLY
1	High water damaged one mile of picnic area of Estes Park.	✓							✓		
2	Haynes Lake swimming and boating facilities washed out.	✓							✓		
	TOTALS:	2	0	0	0	0	0	0	2	0	

CERTIFIED BY: D.C. Miller TITLE: Mayor PHONE: 666-6666 DATE: 6/5/85

PAGE 1 OF 1 PAGES

7

LOCAL DECLARATION

When local government responds to a disaster emergency situation an official part of this response should include a local disaster emergency declaration.

A local declaration is not necessarily a request for outside assistance. This declaration documents the fact that local government realizes its situation and/or is taking the necessary steps to alleviate a serious condition.

When to Issue--The local declaration may be issued at any point during the development of a disaster emergency situation, but must be issued before requesting outside assistance for restoration and recovery.

Who Shall Initiate the Declaration--The governing body of the political subdivision:

1. City--Mayor, City Council, or
2. County--County Commissioners

Who Shall Receive Copies of the Declaration--State Disaster Emergency Services which will forward information to the Governor's Office.

What Shall Be Included in the Declaration--See sample format on the following page.

SAMPLE DECLARATION

WHEREAS, Scott County suffered damage to roads, bridges, culverts, farmlands, homes, businesses, and other public facilities caused by excessive spring runoff and torrential rains occurring in May and June, 1975; and

WHEREAS, the cost of cleanup, repair and replacement of such damaged facilities is far in excess of County resources available

NOW, THEREFORE, BE IT RESOLVED that the Board of Scott County Commissioners of Scott County, North Dakota, declare this to be a disaster area

DATED at Millerville, North Dakota this 2nd day of July, 1976.

Patrick M. Scott

Patrick M. Scott, Chairman

Scott County Board of Commissioners

8

REQUEST FOR ASSISTANCE

***TO RESTORE AND RECOVER**

Outside disaster emergency assistance is intended to supplement, but not be a substitute for, local government restoration and recovery responsibilities.

When a local government believes outside assistance is necessary to supplement its resources, it should submit a well-documented request to State Disaster Emergency Services. This well-documented request for assistance must contain:

1. A detailed *Damage Assessment* Report.
2. Specific individual and/or public restoration and recovery needs.
3. A copy of the Local Disaster Declaration.
4. The significant contribution the local government will make to alleviate the situation.

State DES will evaluate the request and determine State and/or Federal capabilities to provide appropriate restoration and recovery assistance. State DES will then coordinate the assistance made available.

When to Request--Whenever well-documented statistics demonstrate that local resources cannot handle the situation.

Who to Contact--State Disaster Emergency Services, Box 1817, Bismarck, ND 58505. (Telephone: 224-3300)

Information to Submit--

1. A detailed Damage Assessment Report.
2. Specific individual and/or public restoration and recovery needs.
3. A copy of the Local Disaster Declaration.
4. The significant contribution the local government will make to alleviate the situation.

****SPECIAL NOTE****

Assistance made available is generally contingent upon a justifiable request submitted in a timely manner.

DISTRIBUTION LIST FOR WALSH COUNTY NATURAL DISASTER EMERGENCY OPERATIONS PLAN

1. County Commission

2. County Auditor

3. Grafton Police Chief

4. County Sheriff

5. County Road Superintendent

6. Tax Equalization Director

7. County Health Officer

8. Social Services Director

9. County Extension Agent

10. DES Coordinator (EOC Copy)

R E S O L U T I O N

By virtue of the authority vested in the Board of Commissioners of Walsh County by the North Dakota Disaster Act of 1973, NDCC 37-17.1, we do approve and issue the Walsh County Natural Disaster Emergency Operations Plan.

Upon approval, this plan shall have the full force and effect of law.

Dated this 5th day of October, 19 82.

Chairman
Board of County Commission
Walsh County

Witnesses:

Auditor
Walsh County

Disaster Emergency Services
Coordinator
Walsh County

PRIVATE NONPROFIT FACILITIES

Instructions:

1. Indicate county and political subdivision.
2. Write a description of the damage.
3. Check the type of facility affected.
4. As each item is inspected, decide upon a damage rating of minor, major, or destroyed, and place a "check" in the appropriate box.

   Use the following criteria for rating:

MINOR	MAJOR	DESTROYED
May still be used for its intended purpose of may be restored to service with minimal repairs.	Cannot be used or may be used under limited conditions or reduced levels of service or may be restored to use with extensive repairs.	No longer exists or is damaged to the extent that it is no longer usable and that restoration to use is not technically or economically feasible.

5. Total each column.
6. Sign, date, and forward to State Disaster Emergency Services, Box 1817, Bismarck, ND 58505.

NORTH DAKOTA DAMAGE ASSESSMENT REPORT
Private Nonprofit Facilities

COUNTY: Scott
POLITICAL SUBDIVISION: MilleRVille

Description of Damage: Function, Location, Damage to Structure or Equipment, etc.	TYPE (✓) Educational	Custodial	Emergency	Water Control	Utility	Medical	Religious		DAMAGE (✓) Minor	Major	Destroyed	FOR STATE USE ONLY
MeRcy Hospital, 1200 North 6th StReet						✓				✓		
Basement Flooded: StoRage; Kitchen;												
Utilities All Water-Saturated, 12" Silt												
in basement												
St. ANN's Catholic High School, 800 South State	✓									✓		
Basement South WALL Caved IN- ConcRete												
Block constRuction, Kitchen and PoweR												
PLaNt Flooded												
TOTALS:	1	0	0	0	0	1	0	0	0	2	0	

CERTIFIED BY: Philip C. MilleR   TITLE: MAYOR   PHONE: 666-6666   DATE: 5/5/55

Agr[illegible]ture

NATURAL DISASTER DAMAGE ASSESSMENT REPORT

1. STATE	2. COUNTY	3. Number of Farmers IN COUNTY	AFFECTED

4. BRIEF DESCRIPTION AND DATE OF DISASTER(S)

CROPS (Including Timber)	ACRES GROWING IN COUNTY	ACRES DAMAGED	NORMAL YIELD (Bu., Etc.)	YIELD LOSS (Percent)	LOSS (Dollar)	LIVESTOCK AND POULTRY	NUMBER LOST	NUMBER STRANDED	LOSS (Dollar)
5.						10. Cattle			
6.						11. Sheep			
7.						12. Hogs			
8.						13. Poultry			
9.						14. Other			

FARM BUILDINGS AND EQUIPMENT	NUMBER DESTROYED	NUMBER DAMAGED MAJOR	NUMBER DAMAGED MINOR	LOSS (Dollar)
15. Homes				
16. Mobile Homes				
17. Service Buildings				
18. Machinery & Equipment				
19.				
20.				

OTHER DAMAGE OR LOSSES			DOLLARS
21. To Cropland			
22. Other (feed, farm supplies, household goods and personal possessions) List in remarks.			
AGENCY PROGRAMS AFFECTED			
23. FmHA Loans Total estimated loans	NUMBER ANTICIPATED		
24. SCS Section 216 funds needed	TYPE WORK NEEDED		
25. ASCS Estimated disaster payments			
	NO	YES	
ECM Needed			
LFP Needed			

26. CONCURRENCE	CED				SED			
	Yes	NUMBER	No	NUMBER	Yes	NUMBER	No	NUMBER

27. County's gross farm income last year — AMOUNT $

28. REMARKS

CHAIRMAN, CED (Signature)	DATE	CHAIRMAN, SED (Signature)	DATE

WALSH COUNTY

NATURAL DISASTER EMERGENCY OPERATIONS

RESPONSE AND SUPPORT PLAN

TABLE OF CONTENTS

INTRODUCTION

The Walsh County Natural Disaster Emergency Operations Plan is made up of a Basic Document which contains background and general information concerning the threats of various types of natural disasters and actions to be taken if this threat should become reality. In addition to the Basic Document, nine emergency functions have been identified. A reference book is to be developed for each emergency function identified. It should outline specific information prepared by the responsible individuals and agencies so they will understand their responsibilities during the emergency.

Each department, agency, or individual assigned specific responsibilities under this plan should have a broad understanding of the Basic Document and a thorough understanding of their specific tasks as assigned under each emergency function.

This is intended to be a working plan, so you are encouraged to include additional information if it will help you in fulfilling your responsibilities as outlined in the plan. Suggestions for improvement are solicited and should be submitted to the Walsh County Disaster Emergency Services Coordinator whenever you find a better way of doing the job.

AUTHORITIES

North Dakota Century Code, Chapter 37-17.1, as amended

Walsh County Resolution, dated May 6, 1981.

PURPOSE

The purpose of this plan is to:

1. Provide a coordinated effort for saving lives and protecting property in the event of a natural disaster.

2. Support city governments within Walsh County in their efforts to save lives and protect property during a natural disaster emergency.

3. Define the responsibilities of agencies and departments of county government in preparation for, response to, and recovery from a natural disaster emergency.

ASSUMPTIONS

A disaster emergency is not a situation dealt with in the daily activities of Walsh County government. A disaster emergency is the occurrence or imminent threat of widespread or severe property damage, injury or loss of life resulting from any natural or man-made cause.

The greater hazards to Walsh County are tornadoes, winter storms, floods, hazardous materials, and structural fires.

State and federal assistance is a supplement to, but not a substitute for, Walsh County disaster emergency efforts.

CONCEPT OF OPERATIONS

This plan is in effect when a disaster emergency is declared by the Board of County Commissioners or when a disaster emergency occurs or is imminent in Walsh County. It is the responsibility of county government to respond to disaster emergency situations in all areas of the county. County government recognizes established jurisdictions (i.e., cities). This plan in no way supercedes the responsibility of these jurisdictions to respond to and recover from disaster emergency situations affecting their constituents, but will support these jurisdictions upon request.

The Walsh County Commission has the overall responsibility of control of county government operations to save lives and protect property.

The Walsh County Disaster Emergency Services Coordinator is responsible for coordinating all emergency operations of county government.

All agencies/individuals assigned by this plan are responsible for:

1. Providing equipment and other administrative needs to perform their assigned emergency function.

2. Maintaining necessary records, especially financial, to support their assigned emergency function.

3. Supervising the functions for which they are responsible.

4. Supporting the next higher or lower echelons of government.

5. Developing reference materials; such as, narrative procedures, checklists or lists of equipment and personnel; relating how to accomplish tasks.

Disaster emergency operations will be directed from the Walsh County Emergency Operations Center located at the EOC/Administration Building. When this plan is put into effect, the Emergency Operations Center will be activated and individuals having the primary responsibility for each of the following emergency functions will relocate to the EOC to direct response operations:

Coordination and Control. . . . . . County Commission

Administration. . . . . County Auditor

Warning . . . . Grafton Police Chief

Communications. . . . . Grafton Police Chief

Public Works and Engineering. . . .	County Road Superintendent
Damage Assessment	Tax Equalization Director/ County Road Superintendent
Health and Medical.	County Health Officer
Public Safety	County Sheriff
Individual and Family Assistance. .	Social Services Director

Disaster Emergency Operations will be conducted in two phases:

1. <u>Response to the disaster</u>: When a disaster emergency is imminent or occurs, the main response of Walsh County is to save lives and protect property. When Walsh County officials determine that response to the disaster emergency situation is warranted, they will activate this plan. Agencies/departments of county government who have a response function will perform tasks as outlined under their assigned functions until such time that there is no longer any threat to lives and property.

2. <u>Recovery from the disaster</u>: Once the threat of the disaster emergency situation has passed, saving lives and protecting property is no longer the prime consideration. Agencies/departments of county government who have a recovery function will perform tasks as outlined under their assigned function until the County Commission determines that normal day-to-day government operations can resume.

The relationship between the departments of county government and the functional areas is portrayed on the Department/Function Chart on the following page.

WALSH COUNTY
DEPARTMENT/FUNCTION CHART

P - PRIMARY RESPONSIBILITY
S - SUPPORT RESPONSIBILITY

DEPARTMENT / EMERGENCY FUNCTION	Coordination and Control	Administration	Warning	Communications	Public Works and Engineering	Damage Assessment	Health/Medical	Public Safety	Individual & Family Assistance		
County Commission	P				S						
County Auditor	S	P									
Grafton Police Chief			P	P				S			
County Sheriff			S	S				P			
County Road Superintendent					P	P					
County Supt. of Schools					S						
Tax Equalization Director						P					
County Agent						S					
Water Resources Board						S					
County Health Officer							P				
County Health Nurse							S				
Hospital Administrators							S				
Abmulance Services							S	S			
Fire Chiefs								S			
Social Services Director									P		
Ministerial Association									S		
Red Cross									S		
Salvation Army									S		
Mennonite Disaster Relief									S		
DES Coordinator	S	S	S	S	(P)	(P)	S	S	S		
Shelter Officer									S		
U.S.D.A. Emergency Board						S			S		
County Treasurer		S									
States Attorney	S	S									

COORDINATION AND CONTROL

PRIMARY RESPONSIBILITY: COUNTY COMMISSION

PURPOSE: To provide for coordination of County resources during disaster emergency operations.

RESPONSE TASKS	RESPONSIBILITY	REFERENCE
Activate disaster headquarters	County Commission	A
Provide a briefing for the Emergency Operations Staff	County Commission/ DES Coordinator	A
Coordinate disaster operations	DES Coordinator	All References
Prepare initial report to State government	DES Coordinator	ND Procedures Handbook I, Step 1
Review predetermined on-scene disaster coordinator(s)	County Commission/ DES Coordinator	C
Evaluate disaster or emergency situation	County Commission/ DES Coordinator	ND Procedures Handbook I, Step 2 (I/B)
Initiate record keeping and documentation	County Auditor	ND Procedures Handbook I, PGS 10-19
Determine appropriate actions to save lives and protect property	County Commission	ND Procedures Handbook I, Step 2 (J,B)
Prepare situation report to State Government	DES Coordinator	ND Procedures Handbook I, Step 3 (B)
Review and utilize mutual aid agreements	County Commission	D
Provide disaster related public information	County Commissionn	E

RESPONSE TASKS	RESPONSIBILITY	REFERENCE
Declare a local disaster emergency	County Commission	ND Procedures Handbook I, Step 7 (G,B)
Establish curfews, policies and other controls	County Commission	
Request specific assistance from State government to save lives and protect property	County Commission	B ND Procedures Handbook I, Step 4, PG 22
Direct utilization of support resources provided by state government	County Commission	F,H
Continually reassess the disaster situation	County Commission/ DES Coordinator	B ND Procedures Handbook I, Steps 2 & 5 PG 8 & 23
Call for Damage Assessment to begin	County Commission	

NOTE: Specific Contingency Plans (*i.e., Flood, Snow Removal, Summer* Storms, Hazardous Materials, Wildland and Major Structural Fires) should be referenced in this book independently and should be referenced to the following task: Determine appropriate actions to save lives and protect property.

RECOVERY TASKS	RESPONSIBILITY	REFERENCE
Declare a local disaster emergency	County Commission	B ND Procedures Handbook I, Step 7, PG 46
Request assistance from State government to restore property and recover from the disaster	County Commission	B ND Procedures Handbook I, Step 8, PG 48
Appoint a local overall coordinating officer to recover	County Commission	
Provide a briefing of all emergency function coordinators so they may provide input to Damage Assessment	County Commission/ DES Coordinator	

ADMINISTRATION

PRIMARY RESPONSIBILITY: County Auditor

PURPOSE: To provide a system for handling disaster emergency related legal, fiscal, and administrative matters.

RESPONSE TASKS	RESPONSIBILITY	REFERENCE
Provide administrative support to disaster operations (record keeping, documentation and fiscal)	County Auditor/ County Treasurer	ND Procedures Handbook I, PGS 10-19
Provide legal advice to support disaster operations	States Attorney	
Provide clerical support for the disaster headquarters	County Auditor	
Provide necessary equipment and supplies for operations of disaster headquarters	County Auditor	
Prepare disaster headquarters for emergency operations to include maps and other display materials	County Auditor/ DES Coordinator	

RECOVERY TASKS	RESPONSIBILITY	REFERENCE
Provide administrative support to disaster operations (record keeping, documentation, and fiscal)	County Auditor/ County Treasurer	ND Procedures Handbook I, PGS 10-19
Provide legal advice to support disaster recovery operations	States Attorney	

WARNING

PRIMARY RESPONSIBILITY: Grafton Police Chief

PURPOSE: To establish procedures and provide a network for dissemination of disaster emergency warnings.

RESPONSE TASKS	RESPONSIBILITY	REFERENCE
Receive and disseminate warning	Grafton Police Chief	

C O M M U N I C A T I O N S

PRIMARY RESPONSIBILITY: Grafton Police Chief

PURPOSE: To provide the county with a communications network for the transmission of disaster emergency information.

RESPONSE TASKS	RESPONSIBILITY	REFERENCE
Provide a communications network for disaster emergency operations	Grafton Police Chief	
Provide a message routing system within the disaster headquarters	Grafton Police Chief	

PUBLIC WORKS AND ENGINEERING

PRIMARY RESPONSIBILITY: COUNTY BRIDGE FOREMAN

PURPOSE: To provide for the preservation of life and property through engineering tasks in the County. To provide for snow and debris clearance from streets, highways, shelters, utilities, and essential facilities. To provide for the emergency repair of essential facilities in the County.

RESPONSE TASKS	RESPONSIBILITY	REFERENCE
Activate Public Works and Engineering Staff	County Bridge Foreman	A
Maintain public utilities services	Utility Company Mngrs.	A
Provide emergency debris removal	County Bridge Foreman	A,B,C
Direct support resources	County Bridge Foreman	C,F
Coordinate transportation resources	County Supt. of Schools	D
Monitor public and private fuel utilization	County Shop Foreman	E
Maintain roadways, culverts, and bridges	County Bridge Foreman	A,B,C
Take actions necessary to minimize damage to public and private property (diking, barricading, disconnect utilities, etc.)	County Bridge Foreman/ Utility Companys	A,B,C
Support City government as requested in the above areas	County Commission	A,B,C

(NOTE: Specific Contingency Plans (i.e., Flood, Snow Removal, Summer Storms, Hazardous Materials, Wildland and Major Structural Fires) should be referenced in this book independently and should be referenced to the following tasks. Take actions necessary to minimize damage to public and private property.)

DAMAGE ASSESSMENT

PRIMARY RESPONSIBILITY: COUNTY TAX EQUALIZATION DIRECTOR

PURPOSE: To provide a system for assessing property damage after a disaster emergency in the county.

RECOVERY TASKS	RESPONSIBILITY	REFERENCE
Activate Damage Assessment Staff	Tax Equalization Director	A
Conduct Damage Assessment of:		B,D,C ND Procedures Handbook I, Step 6, PG 25
a. Private residences	Tax Equalization Director	E
b. Private business	Tax Equalization Director	F
c. Private non-profit facilities	Tax Equalization Director	G
d. Agriculture	USDA Emergency Board	H
e. Debris	County Bridge Foreman	I
f. Public road systems	County Bridge Foreman	J
g. Public utilities	Utility Company Managers	K
h. Public water control facilities	Water Management District	L
i. Public building & equipment	Tax Equalization Director	M
j. Other	Tax Equalization Director	N

HEALTH AND MEDICAL

PRIMARY RESPONSIBILITY: County Health Officer

PURPOSE: *To provide for health and medical services in time of a disaster emergency.*

RESPONSE TASKS	RESPONSIBILITY	REFERENCE
Provide support for emergency medical care	County Health Officer	
Provide support to control disease through necessary health measures	County Health Officer	

PUBLIC SAFETY

PRIMARY RESPONSIBILITY: County Sheriff

PURPOSE: To provide a means for the protection of life and property and maintenance of law and order during disaster emergency situations.

RESPONSE TASKS	RESPONSIBILITY	REFERENCE
Provide support to maintain law and order	County Sheriff/ Police Chiefs	
Provide support to control and suppress fires	Fire Chiefs	
Provide support to search and rescue efforts	County Sheriff/Police Chiefs/Fire Chiefs/ Ambulance Services	

RECOVERY TASKS	RESPONSIBILITY	REFERENCE
Provide support to maintain law and order	County Sheriff/ Police Chiefs	

INDIVIDUAL AND FAMILY ASSISTANCE

PRIMARY RESPONSIBILITY: County Social Services Director

PURPOSE: To provide county disaster emergency victims with services tailored to meet special and priority human needs.

(N.E.H.S. - Northeast Human Service)

RESPONSE TASKS	RESPONSIBILITY	REFERENCE
Activate Individual and Family Assistance personnel	Social Services	A
Provide support to shelter individuals and families left homeless as a result of a disaster emergency	Shelter Officer	B
Provide support to mass feeding operations	Red Cross	C
Provide support for the distribution and storage of clothing and essential items for individuals and families in need as a result of a disaster emergency	Salvation Army	D
Provide support for crisis counseling	N.E.H.S. Center	E
Provide storage sites for personal property during evacuation	County Commission	I

RECOVERY TASKS	RESPONSIBILITY	REFERENCE
Provide support for crisis counseling	N.E.H.S. Center	E
Identify and support disaster assistance centers	Social Services	F,G,H

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